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Effects of the Exchange Rate on Sectoral Profits, Value Added, Wages and Employment

by

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Abstract

This paper investigates the three channels through which real exchange rate variations affect the economy, namely, a profit channel, a value added channel, and a labor-market channel. In this study, both aggregate and sector-level data for 20 OECD countries and a panel-version of the Autoregressive distributed lag – Error-correction model (ARDL-ECM) proposed by Pesaran et al. (2001) are used to examine the responses of real profits, real value added, real wages and employment to movements in the real exchange rate. According to the estimation results, a real currency depreciation, defined as an increase in the real exchange rate, tends to raise real profits for two tradable-good sectors, namely, *Agriculture, hunting, forestry and fishing*, and *Manufacturing*, five of the manufacturing subsectors, *Total economy*, and even two non-tradable-good sectors and two service sector aggregates. However, a negative exchange rate impact on the long-run real profits of *Construction* and insignificant responses of the other non-tradable-good sectors are also observed. By further examining the exchange rate influences on value added volumes, I find that a real currency depreciation tends to have similar effects on value added volumes as on real profits. As for real wages and employment, a real currency depreciation depresses real wages for both tradable- and non-tradable-good sectors. Employment tends to rise as domestic currency depreciates for *Manufacturing* and two of its subsectors in the short run, and drop for *Construction*, and *Total services*. Thus, one can conclude that a real currency depreciation more often raises profits for the tradable-good sectors, with real value added growth plus the fall in real labor compensation explaining the positive growth in real profits. For the non-tradable-good sectors, two cases should be considered: for *Construction*, a real currency depreciation causes real value added to drop more than does real labor compensation,

resulting in a profit contraction in the long run. For the other non-tradable-good sectors and aggregates, real value added either is unresponsive to real exchange rate variations, or contracts less than does total real labor compensation, thus giving rise to either insignificant or positive profit responses to real exchange rate movements.

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Introduction

This study will contribute to the literature by pinning down three channels through which exchange rate fluctuations may influence the economy, namely, a profit channel, a value added channel, and a labor-market channel. These three channels are especially important for firms that are internationally involved, such as multinational firms, since exchange rate variations affect both the output produced and the cost structure of these firms and, in turn, their profits. Fluctuations in profits will then further influence the investment decisions of these firms. This paper will be divided into three major chapters, with each one covering one of the three channels mentioned above.

Chapter 1 will investigate how real exchange rate movements affect the real profits of different sectors that comprise the total economy, i.e., the profit channel of the exchange rate. Profits are vital to firms due to their role as an important determinant of capital investment, which is a key driver of productivity growth. Profits can affect firms' investment decisions through their influence on both firms' confidence in expected returns to capital and on their budget constraints. This is especially true for liquidity-constrained firms. As shown in Gilchrist and Himmelberg (1995), if firms are liquidity-constrained (i.e., with limited access to capital markets), higher investment may be achieved through higher profits. Consequently, this study of the exchange rate effects on sectoral real profits is necessary since the different responses of sectors to exchange rate variations can not only help understand how firms make investment decisions but also provide information for policy makers in their exchange rate and industry policy making.

Exchange rate changes can directly affect the prices and output, and in turn, the profits and investment decisions of export and import-competing firms. In response to exchange rate variations, firms can adjust either their price-over-cost markups or their export prices in foreign-currency terms which will, in turn, affect the foreign demand and domestic output. Chapter 2 will thus examine the impact of the real exchange rate on sectoral real value added, or, the value added channel of the exchange rate. This channel determines which sectors of the economy will gain and which will lose when the value of the domestic currency changes. Previous studies suggest that output will increase (decrease) as the domestic currency depreciates (appreciates). However, there is also evidence that output may fall in response to currency depreciations, especially in less developed countries. At the sector level, different output responses to exchange rate variations may be observed for sectors that have different degrees of external orientation.

Chapter 3 will discuss how real exchange rate changes are reflected in real labor cost (i.e., real labor compensation per employee) and employment, i.e., the labor-market channel of exchange rates. The close link between this channel and the labor markets can help understand income distribution across sectors and countries. In addition, given that total real labor compensation, which is a product of real labor compensation per employee and total employment, is one of the key components of real profits, an investigation of this labor-market channel will provide further evidence on how real profits are affected by the real exchange rate through changes in labor costs.

In this study, profits are defined as the difference between value added and total labor compensation of employees (which is equal to labor compensation per employee, or the wage rate, times total employment). Thus, changes in the real profits of a particular sector will be the outcome of changes in either the real value added or total real labor compensation of that sector, or both. In Table 1, the simple correlations between changes in real profits, real value added, total real labor compensation, real labor compensation per employee, total employment and the (un-weighted) real exchange rate are reported for the nine sectors that comprise the total economy, four multi-sector aggregates, and ten manufacturing subsectors. This will provide an overview of how the three channels of exchange rate impacts are connected with one another, and what results might be expected from this study.

Five features can be observed based on the correlation coefficients between each pair of these five variables: (1) Real value added and real profit changes are positively and significantly correlated for all sectors, and a correlation coefficient greater than 0.5 is observed for all but *Community, social and personal services*. (2) Real labor compensation and real profits tend to change in either the same or the opposite directions. The correlation coefficients, however, are typically much smaller than those between changes in real value added and real profits. (3) Since the total real labor compensation of a sector is the product of real labor compensation per employee and total employment of that sector, changes in total labor compensation is found to be positively correlated with changes in either variable.[1] Also, real labor compensation per employee and real profits seem to be more likely to move in opposite directions, while total employment usually changes in the same direction as real profits[2]. (4) Variations in total real labor compensation and in real value added are positively and significantly correlated for all sectors, with the correlation coefficients ranging from 0.185 for *Electricity, gas and water supply* to 0.937 for *Community, social and personal services*. (5) A real currency depreciation, which is defined as an increase in the real exchange rate, tends to be positively correlated with increases in both real value added and real profits, but negatively correlated with real labor compensation per employee and total employment for the tradable-good sectors and a majority of the manufacturing subsectors. By contrast, for the non-tradable-good sectors and multi-sector aggregates, a real currency depreciation is correlated with either an increase or decrease in real profits, but usually with drops in all other three variables. Nevertheless, the correlation coefficients may not necessarily reflect the impacts of real exchange rate variations on those four variables provided that other important factors are not controlled for. It is, therefore, still worth investigating whether there are heterogeneous exchange rate effects across sectors, especially between tradable- and non-tradable-good sectors.

In all three chapters of this study, an ARDL-ECM (Autoregressive Distributed Lag –Error-correction model) framework will be applied to estimate the short- and long-run impacts of real exchange rate variations at both the sector and aggregate levels for 20 OECD countries during the period 1971-2008. It is important to investigate both the short- and long-run responses because a change in the value of a currency may have

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[1] The reason why the correlation between changes in real labor compensation per employee and in total real labor compensation and that between changes in total employment and in total real labor compensation does not sum to 1 for most of the sectors may be explained by the fact that the number of observations for total real labor compensation and for total employment usually differs from one another. Hence, the number of observations for real labor compensation per employee should be equal to either the former or the latter, whichever is smaller. When all three variables have the same number of observations, the correlations should sum to 1.

[2] Negative and significant correlations between real labor compensation per employee and real profits are observed for eight sectors and multi-sector aggregates and two manufacturing subsectors, and positive and significant correlations between total employment and real profits are found for eight sectors and multi-sector aggregates as well as seven manufacturing subsectors.

only transitory effects on some sectors but permanent effects on others. As a result, examining both the short and long-run impacts will allow policy makers to assess which sectors will gain and which will lose from exchange rate changes, and thus make industry policies by taking these factors into consideration.

This paper will contribute to the literature from three aspects: First, the three channels of exchange rate impacts will, for the first time, be investigated for the nine sectors that comprise the economy, ten manufacturing subsectors, and three multi-sector aggregates together with the total economy. In most of the previous studies, attention tends to be focused on either the aggregate level or the manufacturing industries only. However, the influences of exchange rate changes on profits, value added, wages and employment may vary substantially across sectors or even among firms within narrowly defined industries, due to difference in their capital intensity, competitive structure and external orientation. Moreover, investigating the manufacturing industries, which have the largest shares in total international trade of goods and services, can obviously provide some evidence of disparity in exchange rate impacts and also help the policymakers to decide if any policy tools are needed to boost exports. It is, however, also necessary to take into account the responses to exchange rate fluctuations of the non-tradable-good sectors, given their share in total economy, and that the prices of imported goods, such as machinery and equipment, vehicles, and tools, which are also used in the production of non-tradable goods, may directly affect their operational costs and profits as well. In addition, international trade in services has been rising dramatically over the past 40 years.[3] Even though service trade is still hard to measure and data is usually incomplete, the inclusion of the service sectors in this study may still provide us with new perspectives of how exchange rate influences propagate across the economy.

Second, this paper investigates the exchange rate effects through the three channels by pooling sector-level data across 20 OECD countries, while in most of the previous empirical research, either only one economy is considered, or a small group of countries are examined separately. By pooling data together, a much larger dataset can

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[3] See Appendix E for details.

be obtained, which will make it possible to exploit variations in the data across countries and also provide evidence that is more generally applicable.

Third, a panel version of the ARDL-ECM approach proposed by Pesaran et al. (2001) is adopted in the empirical analysis. This approach can not only help to recognize both the short- and long-run exchange rate effects, but also has some advantages over the traditional methods employed in analyzing long-run relationships and dynamic interactions among variables. The findings will, in turn, provide foundations for understanding firms' short- and long-run investment decisions and may also provide guidance for government policy making.

To preview the key results (Table 3.14-3.15), real exchange rate variations tend to affect the tradable- and non-tradable good sectors in opposite directions. For the tradable-good sectors, including Agriculture, hunting, forestry and fishing, and Manufacturing, and most of the manufacturing subsectors, a real depreciation of the domestic currency tends to raise real profits, real value added (and value added volumes) and employment, but lower real wages, especially in the short run. The exchange rate-induced movements in real wages and employment are typically smaller than those in real value added, and they also tend to somewhat offset each other due to their opposite directions of movement, thus leaving only small changes in total real labor compensation. Consequently, the profit growth achieved in these sectors is driven primarily by value added growth. In contrast, for the non-tradable-good sectors, real value added (and value added volumes) either responds inversely or is insensitive to exchange rate shocks, while real wages and employment both tend to decline as the domestic currency depreciates. As a result, real profits can either increase (e.g., Wholesale and retail trade; Restaurants and hotels, Finance, insurance, real estate and business services, Business sector services, and Total services) or decrease (e.g., Construction) or become insensitive to real exchange rate movements (e.g., Community, social and personal services), all depending on the relative strength of changes in real value added and real labor compensation. At the aggregate level, the profit growth is achieved in the short run through both an increase in real value added and a decline in the real wage, and in the long run through a fall in the cost of labor only.

Chapter 1. Effects of the Exchange Rate on Profits

1. Introduction

Capital investment is typically considered as one of the key determinants of productivity growth for an economy. As shown in DeLong and Summers (1991), countries with higher rates of investment in machinery and equipment typically have higher rates of productivity growth. In this regard, profits can be especially important for firms due to their impact on firms' investment decisions and in turn on their capacity, productivity and competitiveness. Firms are likely to invest more if they are able to obtain a higher return to capital. Also, if the firms are liquidity constrained, then their investment will be more sensitive to their cash flow fluctuations (Fazzari, Hubbard and Petersen, 1988) and thus will be more likely to increase as profits rise (Gilchrist and Himmelberg, 1995).

For firms that have foreign-currency based activities, especially for multinationals, fluctuations in the exchange rate will affect the relative prices of their goods sold in the home and foreign markets, and cause large variations in the marginal costs of these firms located in different countries, resulting in sensitivity of their profits to exchange rate changes. Fluctuations in profits will in turn influence investment either by enhancing (weakening) firms' expectations of potential returns to their new investment or by relaxing (tightening) their budget constraints. This effect of exchange rate movements on the profitability (or value) of firms is termed *exchange rate exposure*, which reflects the sensitivity of cash flows of a firm to exchange rate changes, or reflects how the profitability of a firm responds to exchange rate fluctuations (Kizys and Pierdzioch, 2006).

One reason why the effects on profits of exchange rate variations should be paid more attention is that these effects tend to be too important to be neglected. For example, Clarida (1997) finds that US manufacturing profits decreased by at least 25 percent following an appreciation of the US dollar in the early 1980s; however, after the dollar depreciation in the late 1980s, profits increased by at least 30 percent. Such significant variations in profits caused by exchange rate changes could in turn lead to fluctuations in the investment level and also output of the manufacturing industry.

Further, an understanding of how profits change with movements of the exchange rate may help in understanding the propagation of exchange rate changes across the economy. The effects of exchange rate fluctuations on profits will not only affect the employment and welfare of workers in different industries, but also investment, savings and consequently the long-run growth of the economy (Hung, 1992-1993).

To preview the results, the real exchange rate, which is defined in such a way that an increase represents a depreciation of the domestic currency, is found to positively affect the real profits for some tradable good sectors, including *Agriculture, hunting, forestry and fishing* and *Manufacturing* in both the short and the long run, and inversely affect the long-run profits of *Construction*, which is a non-tradable good sector. Although the non-tradable good sectors, especially services, are typically considered much less internationally involved than are the tradable-good sectors, the real profits of two multi-sector aggregates, namely *Business sector services* and *Total services*, are both significantly and positively responsive to real exchange rate movements in the short run. Positive and significant profit-exchange rate relationships are also observed for two individual service sectors in either the short or the long run. These positive exchange rate impacts may be driven by the increase in service trade, and in turn, the degree of openness of the service sectors, in the past 40 years. Nonetheless, the scales of these profit changes induced by exchange rate variations are rather small in all four cases. For *Total economy*, there is also a positive and significant relationship between the real exchange rate and real profits in both time horizons. In addition, at both the sector and aggregate levels, the influences on real profits of the real exchange rate tend to be stronger in the long run than in the short run, probably due to the facts that short-run exchange rate exposures can be more effectively hedged relative to long-run exposures and that firms are more capable of adjusting their production to meet foreign demand in the long run than in the short run. Among the ten manufacturing subsectors, the real profits of five are significantly and positively related to the real exchange rate, in either the short or the long run, or both. Moreover, significant exchange rate effects on profits tend to occur in those subsectors in which commodities are produced, and also in the non-durable-goods subsectors.

2. Literature Review

2.1. The Profit Measures and Role of Profits in Investment

Investment is an important determinant of short-run cyclical fluctuations as well as long-run growth and productivity (Landon and Smith, 2008). The investment demand of a firm is closely related to its profitability. Marglin and Bhaduri (1990) argue that higher profitability is a precondition for investment and growth to recover in developed industrialized countries. Uctum (1998) also shows that most of the turning points in the investment-output ratio coincide with or follow the turning points in the share of corporate profits in income for the US from the mid-1970s to the 1990s, suggesting that there is a strong positive relationship between investment and profits. However, an important issue here is how the profitability of a firm should be measured and how it is affected by different economic factors.

So far, several different measures have been used in the literature to proxy profitability. In the closed-economy and finance literature, investment is typically considered to be highly correlated with cash flows or other measures of internal funds (Gilchrist and Himmelberg, 1995). The cash flow of a firm reflects its liquidity constraint (Uctum, 1998). Current and past cash flows can also provide information about a firm's future profitability of investment (Uctum, 1998), based on the evidence that a large fraction of the variance of investment can be explained by cash flows, as long as the Tobin's Q or accelerator variables are controlled for (Fazzari, Hubbard, and Petersen, 1988; Whited, 1992; Chirinko, 1993; Gilchrist and Himmelberg, 1995). More specifically, there are two important reasons why cash flows, or the actual profits, of a firm are considered a key determinant of investment.

First, when financial markets are imperfect, so that firms only have limited access to external funds, it is typically believed to be cheaper to finance an investment project with internal funds than with external funds. During the periods when current profits are high and, hence, more funds will be available for future investments, firms will tend to invest more. In this case, rises in cash flows relax financing constraints, and increase investment by reducing the shadow cost of capital (Gilchrist and Himmelberg, 1995). Therefore, with imperfect financial markets, the retained earnings and the corporate financial structure will be vital in a firm's investment decision process. Its investment would thus be determined by variations in cash flows (Fazzari, Hubbard and Petersen, 1988; van Ees, Kuper and Sterken, 1996). Fazzari et al. (1988) demonstrate that firms' investment is sensitive to their cash flow fluctuations, and cash flow tends to have a more significant influence on the investment of low-dividend firms than on that of high-dividend firms, which are assumed to be less likely to be financially constrained. Gilchrist and Himmelberg (1995) also find a stronger effect of cash flow on investment for financially-constrained firms, even after cash flow is controlled for in its role in forecasting future investment opportunities. However, if the capital markets are perfect, external finance will be a perfect substitute for internal funds. In this case, firms' investment decisions should be independent of their financial condition. Moreover, firms would prefer to use external funds to smooth their investments, when their internal capital fluctuates.

Second, higher actual profits are usually an indicator of a more favourable economic environment and more investment opportunities. In other words, firms will tend to adjust their expected rate of return upwards as current profits increase and, thus, are likely to invest more accordingly (Gilchrist and Himmelberg, 1995).

The rate of return to capital, or the profit rate, defined as "the ratio of the gross operating surplus (capital income) to gross capital stock evaluated at the replacement cost" (Uctum and Viana, 1999, pp.1642), is a traditional measure of a firm's profitability and is generally thought to be relevant to investment. An increase in the rate of return to capital can be attributable to either a rise in capital productivity or a rise in the capital-income ratio. Uctum and Viana (1999) investigate the reasons underlying the decline of US industry profit rates since the 1950s. They find that this decline can mainly be attributed to supply-side factors, technology, and real factor prices. In particular, from the aggregate perspective, sectoral factor productivities and real factor prices play the key role in the declining trend. At the sector level, however, the real wage is found to have a larger impact on the profit rates of manufacturing industries, while the real capital price has a stronger effect on the profitability of non-manufacturing industries.

Residual income has traditionally been recommended as an internal measure of firm performance (Solomons, 1965) and also as an external measure for financial reporting (Anthony, 1973). Recently, a variant of residual income, namely Economic Value Added, or EVA, is used instead of earnings or cash from operations as a measure of both internal and external performance of firms (Biddle, Brown and Wallace, 1997). O'Byrne (1996) defines EVA as net operating profit after tax minus a charge for all capital invested in the business. He argues that EVA is superior to profits in measuring the market value of firms and finds that changes in EVA explain more of the variation in stock returns (or market value) than do changes in profits. Moreover, the level of EVA also explains more of the variation in market value than does the level of profits. Nevertheless, Biddle et al. (1997) find little evidence that EVA is a better measure than profits in its association with stock returns or firm values and suggest instead that profits generally outperforms EVA. Tsuji (2006) also finds that EVA only has limited effect in capturing corporate market values, both in levels and changes.

Due to the role of profits in enhancing firms' confidence in potential returns to new investment and providing firms with more funds, profits are typically assumed to be positively related to investment. Nevertheless, there is also a possibility that profits and investment will move in different directions. It is observed that, since the early 1980s, accumulation rates have been declining while profit shares and rates have been rising in a number of important OECD countries. This is the so-called "investment-profit puzzle" (van Treek, 2008). According to van Treeck (2008), increased shareholder influence on firms, which is reflected by a higher dividend payout ratio, depresses investment but stimulates profits through a higher propensity to consume by the recipients of capital income. Stockhammer (2005-2006) also finds that, under reasonable assumptions, an increase in shareholder power will lead to a decline in aggregate investment expenditures.

As for the determinants of profits, McDonald (1999) finds that firms' profit margins are inversely related to union density, to the degree of import competition, and to the magnitude of wage inflation, and are positively related to industry concentration. Stephan and Tsapin (2008) show that the ownership structure and regional location of a firm have significant impacts on its profitability. In particular, there exists a negative relationship between profits and ownership concentration. Also, cross-shareholding and agency issues play a role in explaining profits in emerging markets.

2.2. Studies on the Exchange Rate and Profits

In the open-economy literature, the profit share (e.g., Okun and Perry, 1970; Nordhaus, 1974; Uctum, 1998; and Ellis and Smith, 2007), real profits (Clarida, 1997; Hung, 1992-1993, 1997; and Forbes, 2002a), and cash flows (Friberg and Ganslandt, 2007) are all used as measures of profitability.

Uctum (1998) defines the profit share as the ratio of nonfinancial gross operating surplus to nominal output. Using a pricing-to-market model following Marston (1990), she demonstrates that a real currency depreciation raises the profit share in all four countries (i.e., the US, Japan, Germany and Canada), and a more elastic foreign demand makes small countries, such as Canada and Germany, likely to have large exchange rate elasticities. Also, a currency appreciation hurts the US profit share three times more than the Japanese and German profit shares since the imported energy price is reduced by the currency appreciation in Japan and Germany, but not in the US. Ellis and Smith (2007) investigate the causes of the strong profit growth in many developed economies in recent years. They define the profit share as the share of factor income going to capital, or the return on capital. They find that the real effective exchange rate has a weak but significantly positive effect on the profit shares in all six models considered.

Hung (1992-1993) examines the influence of exchange rate fluctuations on both US aggregate manufacturing profits and the profits of exporting and import-competing firms from 1973 (i.e., when floating exchange rates were introduced) to 1990. Hung finds that a sustained real appreciation of the dollar causes a large reduction in US manufacturing profits in the long run. The dollar appreciation in the first half of the 1980s led to a drop of about 10 percent of total gross manufacturing profits during the 1980s. Moreover, the influence of exchange rate movements on profits tends to be greater for exporting firms than for import-competing firms. Clarida (1997) also shows that real dollar depreciations have a significantly positive and roughly one-for-one impact on US manufacturing profits. A similar result that a one percent dollar depreciation leads to about 0.94 percent rise in the overseas profits of US multinationals is found in Hung (1997). Forbes (2002a) shows that, immediately after a currency devaluation, the output growth rates of commodity firms in the devaluing countries are about 10%-20% higher than competitors in other countries, while the profit growth rates are about 15%-25% higher. This is because the currency devaluation lowers the relative cost of labor in the devaluing countries. In the long term, however, as the currency devaluation raises the relative cost of capital for firms in the devaluing countries, the impact of devaluations on output and profits will be determined by capital-labor ratios and changes in the cost of capital. In other words, currency devaluations benefit firms in the devaluing countries in the short run through cheaper labor, but decrease their output, profits, and investment in the long run if these firms are capital-intensive and/or capital becomes costly for them. Goldberg (2004) constructs three industry-specific real exchange rate measures and examines their impacts on US corporate profits for eight manufacturing and six nonmanufacturing industries during the period 1970:1 to 2003:2. The estimation results show that, among the subset of five industries with the highest degree of trade orientation, dollar appreciations (depreciations) reduce (stimulate) corporate profits.

Exchange rate fluctuations can directly affect the prices, costs and output of the firms that have foreign currency-based activities and, in turn, their cash flows and firm values. Friberg and Ganslandt (2007) examine the impacts of exchange rate changes on firms' cash flows. They argue that the exchange rate effects on profits hinge on how prices respond to exchange rate variations and on how sales respond to changes in the own prices of the firms as well as in the prices of their competitors. Their results indicate that even in a relatively simple market, different brands of the same product will face very different exchange rate risks.

Studies that investigate the factors that influence the relationship between the exchange rate and investment show that the external orientation of a firm, which is measured by the share of foreign sales out of total sales (or the export share) and its reliance on imported inputs, plays a crucial role in the investment decision-making process (Campa and Goldberg, 1999; Nucci and Pozzolo, 2001). In particular, the investment level of a firm should be positively related to the export share and negatively related to its reliance on imported inputs. Forbes (2002b) confirms this by showing that firms with foreign sales, a lower capital-labor ratio[4] (i.e., relying less heavily on imported inputs), and a lower debt ratio tend to perform better after a currency depreciation. In addition, stronger responses of investment to exchange rate variations also tend to occur in more highly competitive industries (i.e., the industries in which the producers have little price-setting ability) (Campa and Goldberg, 1995, 1999, 2001) and low-markup industries (Campa and Goldberg, 1995, 1999; Allayannis and Ihrig, 2001; Atella, Atzeni, and Belvisi, 2003; Harchaoui et al., 2005). Moreover, firms with a smaller share of innovative investment, a lower R&D intensity, or a smaller degree of product differentiation also tend to be more sensitive to exchange rate movements (Atella et al., 2003). Given that profits and investment are positively related in general, we should expect these factors to influence the profit-exchange rate relationship in the same direction as they do to the relationship between investment and the exchange rate.

3. The Theoretical Model

Assume that, in a world of only two countries, each country has n sectors of production. A representative firm in sector i $\left(i = 1, 2, ..., n\right)$ of the domestic country produces and sells products to both the domestic and foreign markets using both domestic and imported inputs. This firm uses non-tradable domestic inputs, L_i, such as labor and land, and imported intermediate inputs, M_i, to produce output, according to the following production function:

$$Q_i + Q_i^f = f\left(L_i, M_i\right) \tag{1.1}$$

where Q_i and Q_i^f are the outputs of the representative firm in sector i of the home country produced for the domestic and foreign markets, respectively. Following Marston (1990), the domestic and foreign demands for the firm's output depend on the relative prices and the real income in the domestic and foreign countries, respectively. In particular, the demands, by assumption, are decreasing with the relative prices set by

[4] Capital-labor ratio can be used as a rough proxy for the use of imported inputs in production for most emerging market economies since a large proportion of their capital is imported (Forbes, 2002).

the representative firm in the domestic and foreign markets, and increasing with the real GDP in both countries.

$$Q_i = Q_i\left(\frac{P_i}{P}, Y\right),\ \partial Q_i / \partial\left(P_i/P\right) < 0,\ \partial Q_i / \partial Y > 0 \tag{1.2a}$$

$$Q_i^f = Q_i^f\left(\frac{P_i^f}{P^f}, Y^f\right),\ \partial Q_i^f \Big/ \partial\left(P_i^f / P^f\right) < 0,\ \partial Q_i^f / \partial Y^f > 0 \tag{1.2b}$$

where $P_i, P_i^f =$ the prices of the representative firm's output sold in the domestic and foreign markets, respectively. P_i^f is expressed in the foreign currency.

$P, P^f =$ the general price levels in the domestic and foreign countries, respectively. P^f is expressed in the foreign currency.

$Y, Y^f =$ the real income in the domestic and foreign countries, respectively.

The representative firm maximizes its profit subject to the production function in eq. (1.1), (1.2a) and (1.2b):

$$\begin{aligned}\max_{P_i, P_i^f, L_i, M_i} \frac{\Pi_i}{P} = \frac{P_i}{P} Q_i\left(\frac{P_i}{P}, Y\right) + \left(\frac{EP^f}{P}\right)\left(\frac{P_i^f}{P^f}\right) Q_i^f\left(\frac{P_i^f}{P^f}, Y^f\right) \\ - \frac{W}{P} L_i - \left(\frac{EP^f}{P}\right)\left(\frac{P_M^f}{P^f}\right) M_i\end{aligned} \tag{1.3}$$

where $\Pi_i / P =$ the total real profits of the representative firm measured in its home currency.

$E =$ the nominal exchange rate, which represents the domestic currency price of one unit of foreign currency. Therefore, an increase in E indicates a depreciation of the domestic currency. EP^f / P denotes the real exchange rate.

$W/P =$ the real price of the non-tradable domestic inputs, or, the real wage, and is assumed to be the same for all domestic firms.

P_M^f = the world price of the imported intermediate inputs, expressed in the foreign currency. P_M^f is assumed to be determined in the world market and, hence, is taken as given by the representative firm. EP_M^f/P denotes the real price of the imported intermediate inputs measured in the domestic currency.

Solving the profit maximization problem in equation (1.3) gives:

$$\frac{\Pi_i}{P} = \vartheta_i\left(\frac{EP^f}{P}, \frac{W}{P}, \frac{P_M^f}{P^f}, Y, Y^f\right) \tag{1.4}$$

The real profit of the representative firm in sector i, Π_i/P, is a function of the real exchange rate, EP^f/P, the domestic real wage rate, W/P, the relative price of imported intermediate inputs, P_M^f/P^f, real domestic output, Y, and real foreign output, Y^f. These variables tend to affect the real profits of the representative firm in different manners.

Exchange rate variations can affect a firm's profits through their impacts on the relative prices of and demand for the firm's products sold at home and abroad (i.e., the demand channel), and also through their impacts on the cost of imported intermediate inputs and, in turn, on the firm's marginal cost of production (i.e., the cost channel). Also, the extent to which an exchange rate movement can affect a firm's real profits also depends on the firm's market power in both the domestic and foreign markets, its ability to price to market, as well as the currency of denomination of export prices.

Given the assumption of the theoretical model that the representative firm has some market power both at home and abroad, and that the exports are priced in the foreign currency, following a real currency appreciation, a complete pass-through of the exchange rate (i.e., $\partial \ln P_i^f / \partial \ln\left(EP^f/P\right) = -1$) will lead to a one-for-one increase in the firm's foreign-currency price of exports (P_i^f increases) with the exchange rate change. In this process, the decline in $\left(EP^f/P\right)$ and rise in P_i^f will offset each other, leaving the domestic-currency price of exports unaffected. However, the volume of exports, Q_i^f, will decline due to lower foreign demand for domestic goods as a result of the loss of price-competitiveness (since P_i^f increases relative to P^f), thus putting downward pressure on the firm's total real profits in domestic currency terms. By contrast, if the firm chooses not to pass-through any exchange rate movements (i.e., the zero pass-through strategy, $\partial \ln P_i^f \big/ \partial \ln\left(EP^f/P\right) = 0$), then its foreign-currency export price as well as the volume of exports will stay unchanged, but the domestic-currency price of exports, $\left(EP^f/P\right)\left(P_i^f/P^f\right)$, and the real profits in domestic currency terms, Π_i/P, will both fall, given the general price level in the home country. Typically, when the export price is set in the foreign currency, a real appreciation of the domestic currency will lead an exporting firm with some market power to price to market in order to stabilize its foreign-currency export price and maintain the competitiveness of its products in the export market. This will usually lead to pass-through of the exchange rate that is incomplete but more than zero, especially in the short run. This specific type of pricing-to-market is referred to as local currency price stability (LCPS) (Knetter, 1993). The more competitive the market is, the more likely that LCPS will occur (Knetter, 1993). Nevertheless, if the firm is able to choose the currency in which its exports are priced, the degree of the exchange rate pass-through will become endogenous (Devereux et al., 2004). When the firm sets the export price in domestic currency terms (i.e., producer currency pricing, or PCP), an exchange rate movement will be fully passed through into the price facing the foreign importers, but leave the domestic-currency export price unaffected (Devereux et al., 2004). As a result, the foreign-exchange risk faced with the domestic firm will be minimized.

A real currency appreciation may also positively influence the real profits of the representative firm by pushing down the domestic-currency price of imported intermediate inputs, $\left(EP^f/P\right)\cdot\left(P_M^f/P^f\right)$, and, in turn, the marginal cost of production, all other things being equal. Nevertheless, the exchange rate impact on a firm's real profits through the cost channel is also related to such factors as the firm's reliance on imported inputs, the currency in which the imports are priced, the pricing strategy of the foreign exporter, and whether the domestic firm is a large importer so that it is able to affect the world price. Given the assumptions of the theoretical model that the price of imported intermediate inputs is set in the world market and in foreign currency terms (i.e., PCP), an appreciation of the domestic currency will be fully reflected in the domestic-currency import price. As a consequence, the positive effect on real profits of a real currency appreciation through the cost channel and the negative effect through the demand channel work in opposite directions, leaving the net effect uncertain. A real domestic currency depreciation, on the contrary, should have an opposite but still uncertain impact on the real profits of the representative firm. However, a real depreciation of the domestic currency is also likely to push up the domestic inflation rate through a higher cost of imports. The extent to which the domestic rate of inflation will increase through a higher cost of imported inputs and products as a result of a real currency depreciation depends crucially on the country's reliance on imported inputs as well as its degree of openness to imports[5].

Note that, in the long run, if purchasing power parity (PPP) holds, the real exchange rate should be constant and, as a consequence, the real profits of the representative firm should be unrelated to the real exchange rate. However, substantial deviations from PPP in individual markets have been found in a large body of literature. In addition, even though PPP may hold at the aggregate level, changes in sectoral relative prices may prevent PPP from holding at the sector level. Finally, in this study, the inclusion of the non-tradable-good sectors in the sample, together with the various trade barriers facing the tradable-good sectors in the real world, may both lead to permanent deviations from PPP. As a result, it is reasonable to assume that PPP may not hold in the long run. Therefore, a long-run relationship between the real exchange rate and real profits may exist, especially in the non-tradable-good sectors.

As the real wage rate, W/P, rises, the labor cost, and in turn, the marginal cost of production will increase, thus putting downward pressure on real profits. Similarly, an increase in the price of imported intermediate inputs, P_M^f / P^f, will also push up the marginal cost of production and domestic inflation, other things being equal. As a result,

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[5] For example, Campa and Minquez (2006) investigate the differential impact of changes in the euro exchange rate on the inflation rates of the euro member countries. They find that a common euro depreciation will lead to substantial differences in the inflation rates of the member countries. More importantly, most of these differences are accounted for by the different degrees of openness of the member countries to products imported from countries outside the euro zone.

real profits should be a decreasing function of real wages and the cost of imported inputs.

Demand for the representative firm's products in the domestic and foreign markets, Q_i and Q_i^f , will increase as domestic real GDP, Y , and foreign real GDP, Y^f , grow, respectively. Other things being equal, the firm's real profits in domestic currency terms will increase correspondingly.

For the purpose of estimation, take natural logs on both sides of equation (1.4), and rewrite it as follows:

$$\pi_i - p = \rho_i\left(e + p^f - p, w - p, p_M^f - p^f, y, y^f\right) \tag{1.5}$$

where the lower case letters represent the natural logarithms of the corresponding upper case variables.

Moreover, since the degree of external orientation of a sector can significantly affect its responses to exchange rate movements, following Campa and Goldberg (2001), I further decompose the sources of exchange rate exposure of a sector into two major components, i.e., the revenue exposure through export orientation and import penetration, and the cost exposure through the use of imported inputs. To reflect these channels through which the real exchange rate affects real profits, three sector-specific real exchange rate variables are constructed by interacting the real exchange rate with, respectively, sectoral export orientation (x_i), import penetration (m_i), and the use of imported inputs (q_i). When the three sector-specific real exchange rates are incorporated in the model, equation (1.5) becomes:

$$\pi_i - p = \vartheta_i\left(\left(1 + x_i + m_i + q_i\right)\left(e + p^f - p\right), w - p, p_M^f - p^f, y, y^f\right) \tag{1.5'}$$

where $x_i =$ the share of export sales in total revenue, which is used to measure the degree of export orientation of sector i ;

$m_i =$ the import penetration ratio of the domestic sector i ;

$q_i =$ the share of imported inputs in sector $i's$ total factor inputs.

The three channels through which the real exchange rate takes effect capture the sensitivity of real profits to real exchange rate fluctuations. In particular, export orientation and import penetration measure the vulnerability of the representative firm's revenue to real exchange rate shocks, while the use of imported inputs gives a picture of how real exchange rate variations affect the firm's real profits through its costs. In the case of a real currency depreciation, the larger the share of output that is exported, i.e., the larger the sectoral export orientation (x_i), the more the domestic firm will likely profit from foreign sales. Therefore, given the exchange rate variation, a positive relationship between export orientation and real profits should be expected. However, if the price elasticity of demand for domestic exports is fairly low, then the foreign demand for domestic exports may not change even when the exporting firm fully passes through a real exchange rate movement, especially a real currency appreciation, into its foreign-currency export price. In this case, the real profits in domestic-currency terms may not be affected, and the degree of external orientation is, therefore, irrelevant in the determination of the exchange rate impact on real profits. A real currency depreciation raises the cost of imported intermediate inputs. Consequently, the more heavily the domestic firm relies on imported inputs, the more its real profits will fall following a real currency depreciation. In this regard, a negative relationship should exist between real profits and the use of imported inputs (q_i). Similarly, imported products will become more expensive as the domestic currency depreciates. Consumers will thus switch to cheaper domestic substitutes, which will increase the profits of the domestic firm that competes directly with the foreign exporters. And the higher the import penetration in the domestic market, the more likely that the domestic firm will gain. However, if there are no domestic substitutes (due to product differentiation), or if the import elasticity of demand is very low, or if the foreign exporter prices to market to stabilize its export price in domestic currency terms, the real profits of the domestic firm may not respond to the real currency depreciation.

4. Empirical Application

4.1. Data

In order to estimate the profit equation, an empirical counterpart must be specified for the arguments of the theoretical model of equation (1.4). In the OECD STAN Database for Industrial Analysis[6], two measures of profits are available, namely, Gross operating surplus and mixed income (STAN database identifier: GOPS), and Net operating surplus and mixed income (NOPS). GOPS is defined as Value added at current prices (VALU) minus Labor compensation of employees (LABR) and Other taxes less subsidies on production (OTXS). NOPS is equal to GOPS less Consumption of fixed capital (CFCC). However, since data for Consumption of fixed capital and Other taxes less subsidies on production is unavailable for several countries and for decades for the others, a simplified measure of profits is used. This is Value added at current prices less Labor compensation of employees. In Appendix A, I show that *GOPS* and the new profit measure are highly correlated, and that the estimation results with the new profit measure are very similar to those with GOPS over the same sample period.

Data for VALU and LABR is available in the OECD STAN Database for Industrial Analysis for all nine sectors that comprise the total economy[7], four multi-sector aggregates (i.e., *Non-agriculture business sector*, *Business sector services*, *Total services* and *Total economy*) and ten manufacturing subsectors for all 20 countries[8] under consideration. The time range of a particular series, however, may differ from country to country. For most of the countries in the sample, the value added and labor compensation data can be obtained for the entire sample period, ranging from 1971 to 2008. Nevertheless, there are several countries for which data are only available for much shorter periods, such as Germany, whose record starts in 1991. This missing data problem thus yields a sample that is unbalanced. A table of data availability for each country and each sector is provided in Table C of Appendix C.

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[6] Also called the OECD STAN Database for Structural Analysis.

[7] Data for *Mining and quarrying* is not available for France and Portugal, and data for *Non-agriculture Business Sector* is not available for Ireland.

[8] The countries that are included in the sample are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom and the US.

The exchange rate measure used in this study is the inverse of the real effective exchange rate from the OECD Economic Indicators Database. A rise (decline) in this variable indicates a depreciation (appreciation) of the domestic currency, or, an increase (decrease) in the real price of the foreign good. Following Landon and Smith (2008), the log of the real exchange rate is weighted by the average trade share (i.e., the share of aggregate imports plus exports in total GDP) of each country over the period 1970-2008[9]. The weighting by trade will take into account the large differences in the international trade exposure facing each sample country.

Nevertheless, this trade share measure fails to consider the growing use of imported intermediate inputs in the production of domestic goods (Kandil and Mirzaie, 2003). Therefore, in the extended theoretical model, the real exchange rate is interacted with, respectively, export orientation, import penetration, and the share of imported intermediate inputs in total factor inputs (equation (1.5')), to take account of all these three indicators of openness to trade. However, due to data availability, only two channels, namely, export orientation and import penetration, are explicitly incorporated in the model, whereas the effect of the use of imported intermediate inputs on profits will be captured by the estimated coefficients on the non-interacted real exchange rate. Moreover, the extended model with export orientation and import penetration is only estimated for the three tradable-good sectors, namely, *Agriculture, hunting, forestry and fishing*, *Mining and quarrying*, and *Manufacturing*, *Total services*, *Total economy*, and ten manufacturing subsectors. For the three tradable-good sectors and manufacturing subsectors, exports and imports data is available in the OECD STAN Database, and for *Total services* and *Total economy*, the trade data is obtained from the OECD National Accounts and Historical Statistics. Also, for these sectors and subsectors, modified versions of export orientation and import penetration are calculated: export orientation is calculated as the share of exports in each sector's value added, and import penetration is equal to sectoral imports divided by sectoral value added plus the sector's

[9] In Landon and Smith (2008), the weight is calculated using data for the year before the sample starts (i.e., the year 1970) in order to avoid affecting the exchange rate-investment relationship due to changes in the weight. However, they also mention that if the average of the annual weights for the period 1970-2003 is used as the weight, there will not be any significant change in the results.

imports less its exports.[10] Moreover, to take into account the possibility that the export orientation and import penetration of a particular sector may be highly correlated with the real exchange rate, the average export and import shares for each country over the entire sample period are used in the regression.

Thus, three exchange rate variables, including the trade-weighted real exchange rate, the (un-weighted) real exchange rate interacted with, respectively, export orientation and import penetration, are eventually included in the regression for the tradable-good sectors, manufacturing subsectors, *Total services*, and *Total economy*. This model has an advantage that, if the estimated coefficients on the two interacted real exchange rate variables are insignificant, the model can be reduced to the baseline model[11].

Data for real GDP is obtained from the OECD National Accounts and Main Economic Indicators database. The real price of non-traded domestic inputs is proxied by the average wage of the total economy (i.e., total labor compensation of employees divided by total employment), divided by the general price level, or GDP deflator, of that country. Data for labor compensation and employment is available in the OECD STAN Database for Industrial Analysis, and data for the GDP deflator is obtained from OECD Economic Outlook Statistics and Projections Database.

The price of the imported intermediate inputs, P_M^f / P^f , which is assumed to be determined in the world market, and the real income of the foreign country, Y^f , which can be viewed as world output, are both the same for all sample countries at each point

[10] According to the definitions of the OECD STAN Indicators Database, sectoral production is the denominator of both export share of production and import penetration. The same definition of export share in production is adopted in Campa and Goldberg (2001) as well. However, production data are not available in the OECD STAN Database for Australia in all sectors, and are not complete, relative to value added, for several other countries in some sectors or manufacturing subsectors, especially in *Agriculture, hunting, forestry and fishing*, and *Mining and quarrying*. As a result, if we calculate export orientation and import penetration using production, rather than value added data, the sample size of a sector will shrink considerably, thus making the estimation results generally incomparable with the baseline results. For *Total economy*, since total value added is equal to total GDP, the two definitions will yield the same results.

[11] Note that for this statement to hold, the trade-weighted real exchange rate and other variables must have the same lag lengths in both models.

of time. As a result, the vector of year dummies, θ_{it}, will capture the effect of these variables.[12]

4.2. Estimation Methodology

In the previous literature, some studies examine the impacts of exchange rate variations on profit shares. The profit share measure has an advantage over real profits in the sense that the shares are all in proportions so that they can provide a straightforward comparison of profitability among sectors across different countries. However, there is also a big issue associated with the use of the profit share as the dependent variable in the regression. Since the profit share is calculated as the ratio of sectoral real profits to sectoral real value added, a change in this variable caused by an exchange rate shock may not be able to properly indicate changes in profitability, due to the fact that the impacts of exchange rate movements on sectoral real profits (the numerator) and on sectoral real value added (the denominator) may offset each other to some extent, leading to ambiguous conclusions, especially when sectoral labor compensation and value added change at different rates following the exchange rate shock. It is also likely that real profits and the profit share will vary in opposite directions if the movements of labor compensation and value added are disproportionate[13]. By contrast, the real profit measure will not lead to such ambiguity.

The main purpose of this chapter is to examine how changes in the value of a currency affect the real profits in different industries. Note, however, that an exchange rate shock may have not only a transitory but also a long-run impact on the profits of

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[12] The world GDP facing each country can be constructed and included in the estimation equation, as could the imported input price, which can be proxied by the oil price. However, including both of these variables together with the year dummies (which may capture some other effects leftover from these two variables) are likely to cause the multicolinearity problem.

[13] For example, if, initially, the value added of a tradable-good sector is \$200, its labor compensation is \$100, and the general price level is 1, then the real profits and the profit share of this sector are \$100 and 50%, respectively. Suppose that a domestic currency depreciation (appreciation) increases (reduces) the sectoral value added to \$250 (\$150) through higher (lower) exports, and, at the same time, leads to a higher (lower) cost of imported inputs. The higher (lower) cost of imported inputs pushes up (down) the product price for this sector and then the domestic price level to 1.1 (0.9). If the total labor compensation of this sector rises (declines) to \$120 (\$80) following the price increase (decrease), then the real profits will now become \$118.2 (\$77.8), which are higher (lower) than the initial level of \$100, while the sectoral profit share, by contrast, is reduced (raised) to 47% (52%), which is lower (higher) than the original level of 50%.

particular industries. This makes it both necessary and crucial to pin down both the short-run and the long-run effects on sectoral profits of the exchange rate. Hence the ARDL-based bounds-testing approach proposed by Pesaran et al. (2001) will be adopted.

The reason why the ARDL approach will help to identify the short- and long-run impacts is that the ARDL framework can be turned into an error-correction model (ECM) through simple linear transformations. The error-correction model is a dynamic model that identifies both the short run effects and the long-run equilibrium, with the error-correction term reflecting the speed of adjustment to the long run. Consequently, the ARDL model is able to estimate both the short- and long-run coefficients simultaneously (Baek and Koo, 2006). Moreover, in the context of the ARDL model, the parameters of interest are the long-run coefficients and the speed of adjustment coefficient (Pesaran, Smith, and Akiyama, 1998). In this regard, the ARDL approach proposed by Pesaran et al. (2001) not only allows one to test for the existence of a long-run relationship between the dependent variable and the explanatory variables from the ECM directly, but also has several advantages over other methods of analyzing long-run relationships and dynamic interactions among the variables of interest. First and foremost, OLS can be used to consistently estimate the long-run coefficients as long as the lag structure of the model is identified (Pesaran et al., 2001). The estimates of the long-run coefficients will be super-consistent (or *T*-consistent) when the regressors are integrated of order 1, i.e., $I(1)$, and valid inferences on the long-run parameters can be made using standard normal asymptotic theory (Pesaran and Shin, 1998). Second, even when some of the regressors are endogenous, the long-run relationships estimated using this approach will still be generally unbiased, and the t-statistics will also be valid (Harris and Sollis, 2003). In addition, this approach is especially superior to other methods when the variables involved are integrated of mixed orders. It is applicable regardless of whether the regressors are purely $I(0)$, purely $I(1)$, or mutually cointegrated (Pesaran et al., 2001). Thus, unlike the traditional cointegration methods (such as Engle and Granger, 1987; Johansen, 1995), which deal with cases in which the variables are integrated of the same order (e.g., all the variables are $I(1)$), it does not require the pre-testing of the included variables for unit roots, which can be particularly problematic when the sample period is short (Pesaran, Smith, and Akiyama, 1998). Nevertheless, it is also argued by Ouattara (2004) that, if any of the included variables has an order of integration higher than one, for example, if a variable is $I(2)$, then the critical values provided in Pesaran and Pesaran (1997) and Pesaran et al. (2001), which are calculated based on $I(0)$ and $I(1)$ variables, are no longer valid. However, in this study, there is no reason to expect that the variables included are $I(2)$, which would imply that the growth rates of these variables are growing over time.[14] More importantly, the commonly used unit root tests, including the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, tend to lack power in distinguishing the null of unit root from the stationary alternatives in such a small sample size as in this study. This problem cannot be solved even when the panel versions of these tests, or some other newly developed testing methods, such as the Levin-Lin (LL, Levin, Lin and Chu (2002)), Im-Pesaran-Shin (IPS, Im et al. (2003)) and Fisher's tests, are adopted. Finanlly, the ARDL approach is suitable for both small and infite samples (Pesaran et al., 2001).

The unrestricted panel-version autoregressive distributed lag (ARDL) model with one lag for each variable can be specified as follows,

$$(\pi_i - p)_{ct} = \gamma_i (\pi_i - p)_{c,t-1} + \beta_{i0}^{'} X_{ct} + \beta_{i1}^{'} X_{c,t-1} + \eta_{ic} + \theta_{it} + \varepsilon_{ict},$$

$$i = 1, 2, ..., I, c = 1, 2, ..., C, t = 1, 2, ... T \qquad (1.6)$$

where I is the number of sectors to be investigated, including nine sectors that comprise the total economy, four multi-sector aggregates, and ten manufacturing subsectors; C is the number of countries included in the sample, where for all sectors except *Mining and quarrying*, $C = 20$, while $C = 18$ for *Mining and quarrying*; T is the sample length, which may differ across countries and sectors, but equals 38 if all observations are available for a series. $(\pi_i - p)_c$ is the real profit of sector i in country c, and $(\pi_i - p)_{c,t-1}$ represents the first-period lag of $(\pi_i - p)_{ct}$ with coefficients γ_i;

[14] A test of the order of integration shows that all the included variables are either $I(0)$ or $I(1)$, and none of them is $I(2)$.

$X_c = \left(\left(e + p^f - p\right)_c, \left(w - p\right)_c, y_c\right)'$ is a 3×1 vector of explanatory variables for the baseline model (equation (1.5)), and

$X_c = \left(\left(e + p^f - p\right)_c, x_i\left(e + p^f - p\right)_c, m_i\left(e + p^f - p\right)_c, \left(w - p\right)_c, y_c\right)'$ is a 5×1 vector for the extended model (equation (1.5')), in which, $\left(e + p^f - p\right)_c$ denotes the real price of foreign currency in terms of domestic currency, i.e., the real exchange rate, x_i is the degree of export orientation of the sector i, m_i is the import penetration rate of the domestic market, $\left(w - p\right)_c$ is the average real wage that prevails in country *c*, and y_c is the real GDP of country *c*. $X_{c,t-1}$ is the first-period lag of X_{ct}, and β_{i0} and β_{i1} are 3×1 or (5×1) vectors of coefficients on X_{ct} and $X_{c,t-1}$, respectively; η_{ic}, the intercept specific to each cross-sectional unit, and θ_{it}, the time dummies, are included in the regression to capture the country-specific fixed effects and time effects, respectively; ε_{ict} is a well-behaved error term with zero mean and variance σ_i^2.

To distinguish the short-run impacts from the long-run impacts, re-parameterizing equation (1.6) to yield the error-correction model (ECM) of the ARDL specification:

$$\Delta\left(\pi_i - p\right)_{ct} = \left(\gamma_i - 1\right)\left(\pi_i - p\right)_{c,t-1} + \left(\beta_{i0}' + \beta_{i1}'\right) X_{c,t-1} + \beta_{i0}' \Delta X_{ct} + \eta_{ic} + \theta_{it} + \varepsilon_{ict} \qquad (1.7)$$

where $\Delta\left(\pi_i - p\right)_{ct}$ and ΔX_{ct} denote the first difference of the dependent and explanatory variables, respectively. The coefficient on $\left(\pi_i - p\right)_{c,t-1}$, $\left(\gamma_i - 1\right)$, is called the error-correction coefficient, which measures the deviation from the long-run relationships; while β_{i0} reflects the short-run effects of changes in the explanatory variables on sectoral real profits.

In the long run, both the dependent and explanatory variables grow at a constant rate over time, in other words, a "steady state" is achieved. Therefore, $\Delta\left(\pi_i - p\right)_{ct} = \Delta X_{ct} = 0$, and the long-run parameters can be calculated as follows:

$$\pi_{ic} - p_c = \left(\frac{\beta_{i0}^{'} + \beta_{i1}^{'}}{1 - \gamma_i} \right) X_c \tag{1.8}$$

A more general version of the ARDL model with lags s and q, which, respectively, stand for the number of lags for the dependent and the vector of independent variables, can be written as follows.

$$(\pi_i - p)_{ct} = \sum_{j=1}^{s} \gamma_{ij} (\pi_i - p)_{c,t-j} + \sum_{j=0}^{q} \beta_{ij}^{'} X_{c,t-j} + \eta_{ic} + \theta_{it} + \varepsilon_{ict} \tag{1.9}$$

where $(\pi_i - p)_{c,t-j}$ and $X_{c,t-j}$ represent respectively the *j*-th period lags of $(\pi_i - p)_{ct}$ and X_{ct}, with coefficients γ_{ij} and β_{ij}. Note that q is allowed to differ across the explanatory variables.

Re-writing equation (1.9) into error-correction form with lags (s, q) for the dependent and explanatory variables respectively, yields

$$\begin{aligned} \Delta(\pi_i - p)_{ct} = (\tau_i - 1)(\pi_i - p)_{c,t-1} + \delta_i^{'} X_{c,t-1} + \sum_{j=1}^{s-1} \lambda_{ij} \Delta(\pi_i - p)_{c,t-j} \\ + \beta_{i0}^{'} \Delta X_{ct} + \sum_{j=1}^{q-1} \psi_{ij}^{'} \Delta X_{c,t-j} + \eta_{ic} + \theta_{it} + \varepsilon_{ict} \end{aligned} \tag{1.10}$$

where η_{ic} and θ_{it} are the country-specific fixed effects and time effects, respectively. $(\tau_i - 1) = \left(\sum_{j=1}^{s} \gamma_{ij} - 1 \right)$ is the error-correction coefficient in equation (1.8), $\lambda_{ij} = -\sum_{m=j+1}^{s} \gamma_{im},\ j = 1, 2, ..., s-1,$ are the new coefficients on the changes of the dependent variable; and $\delta_i = \sum_{j=0}^{q} \beta_{ij}$ and $\psi_{ij} = -\sum_{m=j+1}^{q} \beta_{im},\ j = 1, 2, ..., q-1,$ represent the coefficients on the lagged values and changes of the exogenous variables, respectively. The process of transforming the ARDL model into the ECM form is shown in Appendix D.

Alternative methods such as the mean group (MG) and pooled mean group (PMG) approaches to estimation of dynamic panel data models with heterogeneous slopes, proposed respectively by Pesaran and Smith (1995) and Pesaran, Shin and Smith (1999), have the advantage over the current method that homogeneity is not imposed on the coefficients for each country. However, in this present study, the MG and PMG approaches, which involve running separate regressions for each country cannot be applied due to insufficient observations for some countries. More details about the MG and PMG methods can be found in Appendix E.

4.3. Model Estimation

Equation (1.10) is estimated for all the nine sectors, four multi-sector aggregates, and 10 manufacturing subsectors. Given the fact that annual data is used in this study and the panels are highly unbalanced for virtually all sectors, according to Pesaran, Smith and Akiyama (1998), no more than two lags for each variable should be considered. Therefore, two lags are initially assigned to each variable in the estimation equation. The statistically insignificant lags that are first dropped through sequential elimination, and the Schwarz Bayesian Criteria (SBC) is then used as a check for the optimal lengths. The short-run coefficients can be estimated directly using ordinary least squares (OLS), while the long-run coefficient estimates have to be calculated according to equation (1.8) and the standard errors will be derived using the delta method.

The usual assumption that the error term is identically and independently distributed (iid) may be violated in the sense that the errors are conditionally heteroskedastic (Baum, 2006) or the observations within certain groups are correlated in some unknown way (Nichols and Schaffer, 2007). This can prevent OLS from producing efficient estimates of the parameters and consistent estimates of the standard errors. Hence, the robust and robust-cluster estimators of the variance-covariance matrix are adopted. The robust estimator, which specifies the Huber-White-sandwich estimator of the variance in place of the traditional calculation, takes into account heteroskedasticity and places fewer restrictions on the estimator to account for non-iid errors. The estimated coefficients obtained using the robust estimator will still be the same as those obtained using OLS, and only the standard errors of the coefficients and confidence interval estimates will be affected (Baum, 2006, pp.136). The cluster-robust estimator of variance further allows the error terms within each cluster to be correlated, but requires the disturbances from different clusters to be uncorrelated (Baum, 2006, pp.138). Therefore, if the within-cluster correlations are important, then using the robust estimator without the cluster option, which assumes that the errors are independently distributed, will yield inconsistent estimates of the variance (Baum, 2006, pp.138). In this study, the robust clustered-by-country estimator is used, since it would be more reasonable to assume that the error terms are clustered across time within each country, but unclustered across countries.[15] The estimation results for the baseline model and the extended model with export orientation and import penetration are reported in Tables 1.1 (A), 1.1(B) through 1.2, with the estimated coefficients on the country and time dummies not listed.

4.3.1. Error-correction Coefficients

The error-correction coefficient ($\tau_i - 1$) measures the speed of adjustment to the long run. Pesaran et al. (2001) propose a t-test (*PSS* t-test for short) with the null hypothesis that the error-correction coefficient is equal to zero, based on the work of Banerjee, Dolado and Mestre (1998), and compute the critical value bounds for the test. In this test, if the null hypothesis is rejected, the estimates of the long-run coefficients can be calculated directly from the OLS estimates as $\hat{\alpha}_{i,X} = -\hat{\delta}_{i,X} / \left(\hat{\tau}_i - 1\right)$, where $X = \left(\left(e + p^f - p\right)_c, \left(w - p\right)_c, y_c\right)$ (i.e., the baseline model), where $\hat{\delta}_{i,X}$ and $\left(\hat{\tau}_i - 1\right)$ are the estimated coefficients on the lagged explanatory variables and the estimated error-correction coefficient, respectively. Pesaran et al (2001) also show that the estimated long-run coefficients have consistent t-statistics which follow the limiting normal distribution, while the short-run coefficients are $\sqrt{t}$ consistent and have the standard normal distribution (Pesaran et al., 1998b; van Treek, 2008). The PSS *t*-test is conducted at the 5% and 10% significance levels, and the results are reported in Tables 1.1 (A) through 1.2 for the baseline and extended models.

[15] When the robust unclustered or clustered-by-year estimators are used, the estimated coefficients stay unchanged, but the standard errors are in general smaller than those obtained using the clustered-by-country estimator.

According to the test results, the null hypothesis of no long-run relationship between real profits and the explanatory variables can be rejected at the 5% level of significance for nine out of the 13 sectors and multi-sector aggregates in the baseline model. At the 10% level of significance, the hypothesis cannot be rejected only for *Community, social and personal services*, and *Business sector services*. When the extended model is considered, the PSS t-test results do not change significantly.

4.3.2. Real Exchange Rate Parameters

4.3.2.1. Baseline Model

In Tables 1.1 (A) and (B), and in Tables 3.14 (A)-(B) and 3.15 (B)-(C), the estimation results for the baseline model are reported. For the nine sectors that comprise the total economy and the four multi-sector aggregates, the estimation results exhibit three important features.

First, among the nine sectors that comprise the total economy, significant exchange rate effects on real profits are observed for two tradable-good sectors, namely, *Agriculture, hunting, forestry and fishing*, and *Manufacturing*, and for one non-tradable good sector, namely, *Construction*, at the 5% or higher level of significance.

For both *Agriculture, hunting, forestry and fishing* and *Manufacturing*, the exchange rate-profit relationships are positive, indicating that real profits increase as the domestic currency depreciates. Since the exchange rate variable used in the estimation is the trade-weighted real exchange rate, which takes into account the differences in each country's degree of openness, the estimated coefficients on the exchange rate thus measure the marginal effects on real profits of the trade-weighted real exchange rate, rather than the real exchange rate itself. Hence, the exchange rate parameters must be adjusted to reflect only the impacts of real exchange rate changes on real profits, after taking into account the trade shares. In other words, the exchange rate parameters must be multiplied by the trade share, for which, I use the mean of the trade shares for all sample countries over 1971-2008, or, 0.633. Thus, a one percent real currency depreciation is found to raise the real profits of *Manufacturing* by respectively 0.541 (=0.855*0.633) percent and 1.498 (=2.367*0.633) percent in the short and the long run, respectively. Also, a short-run profit increase of 0.669 (= (0.642+0.415)*0.633) percent associated with a one percent real currency depreciation that starts one period back is observed for *Agriculture, hunting, forestry and fishing*.

The real exchange rate also tends to have a negative long-run impact on the real profits of the *Construction* sector, with a profit decline of 0.886 (=-1.4*0.633) percent caused by a permanent one percent real currency depreciation. According to the theoretical model, the real exchange rate can either positively or negatively affect real profits, depending on the relative strength of the exchange rate effects through the demand and the cost channels. Hence, the findings of positive exchange rate coefficients for the two tradable-good sectors and the negative coefficient for the *Construction* sector are both consistent with the prediction of the theoretical model. Particularly, for *Construction*, the negative exchange rate effect could be attributable to its small degree of external orientation and/or heavy reliance on imported inputs, such as construction material, steel, machinery and equipment, etc., so that the cost effect of the exchange rate dominates the demand effect. Apart from *Construction*, there are another two non-tradable-good sectors, namely, *Wholesale and retail trade; Restaurants and hotels*, and *Finance, insurance, real estate and business services*, which exhibit significant and positive profit responses to real exchange rate movements. These two sectors are likely to be more internationally engaged relative to other non-tradable-good sectors. However, their estimated exchange rate coefficients are only significant at the 10 percent significance level.

By comparing the magnitudes of exchange rate impacts across sectors, I find that the real profits of *Manufacturing* exhibit the highest sensitivity to exchange rate shocks. Given *Manufacturing*'s large share in total international trade of goods and services and its export share of production (Table 2.1), this result is consistent with the findings in previous studies that the exchange rate should have greater impacts on those sectors that are more externally oriented. Meanwhile, the finding of insignificant exchange rate influences in the remaining four sectors may be either due to their less involvement in international trade, such as the service sectors, or to the fact that firms make extensive use of financial instruments (i.e., financial hedging) and operational adjustments (i.e., operational hedging) to protect themselves from unexpected variations in the exchange rate (Allayannis and Ofek, 2001; Allayannis, Ihrig, and Weston, 2001, Dohring, 2008). Also, the exchange rate effects through the demand and cost channels may offset each other, resulting in an insignificant net effect.

Generally speaking, based on the estimation results, there appears to be a tendency for the real profits of those tradable-good sectors, which have relatively higher degrees of external orientation, to be positively affected by the real exchange rate; and the real profits of the non-tradable goods sectors that are rarely internationally-involved, such as *Construction*, to be negatively or insignificantly affected. An important implication of this conclusion is that if policy makers attempt to use currency depreciations to promote exports and boost the tradable-good sectors, they have to also take into account the possible adverse impacts on the non-tradable good sectors.

Second, even though the real profits of the service sectors are generally insensitive to real exchange rate variations, the real profits of the service sectors as a whole are significantly responsive to the real exchange rate, although only in the short run. For both *Business sector services* and *Total services*, short-run real profits show small, but positive and significant responses to the real exchange rate, with profit increases of, respectively, 0.082 (=0.129*0.633) percent and 0.065 (=0.102*0.633) percent in these two aggregates associated with a one percent real currency depreciation. This finding appears to contrast with our expectation that the real exchange rate should be positively related to the real profits of the tradable-good sectors and negatively related to those of the non-tradable good sectors, which include all the service sectors. Nonetheless, unlike *Construction*, which typically serves the domestic market only, there is an ascending trend in international trade in services, such as in financial services and information technology, in recent years. This may provide some explanation for the existence of these positive exchange rate coefficients. According to Lipsey (2006), world trade in services now accounts for about a quarter of world trade in goods, and imports of services are increasing more rapidly than exports, although still slower than imports of goods. In Appendix F, I show that, even though the share of service trade in total international trade of goods and services is fairly stable for most of the sample countries during the period 1970-2008 (Figures F.1 and F.2), service exports and imports, have been growing at average annual rates of 9.44 percent and 9.16 percent, respectively (Table F.1). In other words, over the past 38 years, service exports and imports have, respectively, increased by 308.1 percent and 279.52 percent in total. On average, service trade now accounts for about 22 percent in total international trade of goods and services for all the sample countries (Table 2.1). Thus, the increasing external orientation of the service sectors may provide some explanations for the positive relationship between their real profits and the real exchange rate.

Finally, the real exchange rate's impact on sectoral profits tends to be stronger in the long run than in the short run for the *Manufacturing* sector and *Total economy*. This is especially obvious for *Manufacturing*, whose long-run response to the exchange rate is about three times larger than its short-run response. According to Dohring (2008), this may be attributable to the fact that short-run exchange rate exposures can be more effectively hedged than long-run exposures, thus resulting in the stronger exchange rate impact in the long run than in the short run. Moreover, as the domestic currency depreciates, for example, firms that are restricted by the current production capacity may not be able to expand output right away to meet the increasing foreign demand for domestic goods which have now become cheaper in the export market. As a result, the short-run output and profits may be relatively insensitive to real exchange rate variations. In the long run, however, as new factories are built and new equipment installed, firms will be able to increase production on a larger scale. In addition, as the contracts signed prior to the currency depreciation are all due in the long run, firms can also adjust their foreign-currency export prices in order to maximize their profits. Hence, a permanent real depreciation of the home currency should have a much stronger influence on the real profits in the long run than in the short run.

4.3.2.2. Extended Model with Export Orientation and Import Penetration

Estimating the extended model with export orientation and import penetration enables us to evaluate the relative importance of the three channels, namely, the export channel, the import channel, and the "residual" channel that captures all the remaining factors, in the determination of the profit-exchange rate relationships for the three tradable-good sectors, *Total services*, and *Total economy*. The estimation results are reported in Tables 1.2 and 3.15 (B).

For *Agriculture, hunting, forestry and fishing*, and *Manufacturing*, a real currency depreciation has a positive and significant effect on real profits through, respectively, the export and import channels in the short run. Hence, consistent with the predictions of the theoretical model, given a real currency depreciation, the exchange rate impact on real profits tends to be magnified for *Agriculture, hunting, forestry and fishing* as the degree of export orientation increases, and for *Manufacturing* as the degree of import penetration rises. Even though the long-run exchange rate coefficients through the three channels are all insignificant for both sectors, they are jointly significant and positive in both cases. So are the short-run coefficients. Also, in both the short and the long run, the exchange rate impacts through the export channel have the greatest contribution in the final effects of the real exchange rate on the real profits of *Agriculture, hunting, forestry and fishing*. For *Manufacturing*, however, the exchange rate effects through the residual channel dominate in both the short and the long run. Moreover, the magnitudes of the net impacts after adjusting for the trade shares are quite similar in the baseline and extended models for both sectors, suggesting that the exchange rate influences through the three channels tend to offset each other during the aggregation process.

For the sector *Mining and quarrying*, a real currency depreciation significantly influences real profits through the export channel in the short run, and through both the export and import channels in the long run. Moreover, an increase in export orientation raises real profits in the short run but unexpectedly lowers them in the long run, whereas an increase in import penetration is associated with a profit increase in the long run. Nevertheless, consistent with the estimation results from the baseline model, the net effects of real exchange rate movements turn out to be insignificant in both the short and the long run.

The results for *Total services* are quite interesting. In the baseline model, a real currency depreciation leads to a small but significant increase in its real profits in the short run, but not in the long run. In the extended model, even though real exchange rate variations significantly affect the short-run real profits through all three channels, the joint effect is only insignificant. In the long run, a significant (at the 10% level) and positive response of the profits is observed, but the exchange rate effects through the individual channels are all insignificant. However, still consistent with the baseline results, a positive relationship between a real currency depreciation and real profits exists for *Total services*.

At the aggregate level, no significant exchange rate effect through any individual channel is observed in either time period, and yet the joint effects are significant and positive in both the short and the long run, implying higher total profits associated with real currency depreciations.[16]

4.3.3. Real Wage Parameters

Labor costs or wages account for a large proportion of the production costs which directly affect a firm's profits and investment decisions. Therefore, the inclusion of real wages and their lags as explanatory variables should help increase the explanatory power of the model.

Due to their cost feature, real wages are expected to negatively affect profits. This argument is confirmed by the estimation results, even though only a few estimated coefficients are statistically significant. In particular, among the 13 sectors and multi-sector aggregates, real wages significantly affect the real profits of six in the short run, including *Mining and quarrying*, *Manufacturing*, *Wholesale and retail trade; Restaurants and hotels*, *Non-agriculture business sector*, and *Total economy*, and only two in the long run, namely *Agriculture, hunting, forestry and fishing*, and *Total economy*. Moreover, the impacts on real profits of real wages tend to be rather strong, especially in the short run. In particular, a one percent real wage increase leads to profit declines of more than one percent in three sectors and reduces the real profits of *Total economy* nearly one-for-one (0.955 percent) in the short run. The decrease in and loss of influences on real

[16] By calculating the correlation coefficients between the three exchange rate variables included in the extended model, I find significant and high (greater than 0.5 in absolute value) correlations in all sectors, especially between the trade-weighted and export-orientation-interacted real exchange rates. These high correlations may explain why many of the exchange rate coefficients are insignificant. If the extended model is estimated using real exchange rates interacted with, respectively, lagged export orientation and import penetration ratios, instead of their country-average values, some of the exchange rate coefficients will turn significant (e.g., both the short- and long-run estimated coefficients on the trade-weighted real exchange rate will become significant for *Manufacturing,* and *Total economy*). However, the joint effects will not change much, and there will be serious multicollinearity problems for such sectors as *Agriculture, hunting, forestry and fishing*, and *Mining and quarrying.*

profits of real wages in the long run (such as for *Total economy*) may imply that firms tend to gradually switch to more labor-saving technologies and equipment and hence reduce their reliance on labor in the long term.

4.3.4. Real GDP Parameters

A positive and significant GDP-profit relationship is observed for all sectors and multi-sector aggregates in the short run, with the exception of *Electricity, gas and water supply*, whose real profits are inversely affected by real GDP growth, and *Transport, storage and communications*. The importance of real GDP in the determination of real profits drops in the long run, especially in the tradable-good sectors, with significant impacts still observed for nine sectors and multi-sector aggregates. The possible explanations for the decreasing importance of real GDP in the determination of long-run real profits for the tradable-good sectors is that, in the short run, the quantities of some of the inputs are fixed. If there is an external shock to domestic output, firms may not be able to adjust production in the short run fast enough to meet the increasing (or decreasing) demand for their products, thus leading to a larger impact on real profits of a real GDP shock. In the long run, as all inputs become variable, production can be gradually adjusted to meet the new demand. As a result, the effect of real GDP on real profits may drop as time passes. Also, firms in the tradable-good sectors face both domestic and foreign demand for their products and are more capable of increasing profits through export expansion or cost reduction (such as shifting production abroad). Therefore, an adverse shock to the domestic market may be counteracted by increasing exports or shifting production overseas, especially in the long run, which will result in decreasing reliance of the tradable-good sectors' real profits on domestic real GDP. The non-tradable-good sectors, on the contrary, rely primarily on the domestic market in both the short and the long run due to their limited access to foreign markets. The performance of the domestic economy will thus significantly influence the profitability of these sectors at all times.

4.3.5. RESET Test Results

A Ramsey RESET test is adopted to test for general model specification, such as omitted variables and incorrect functional form. This test is carried out by testing the significance of the squared predicted value of the dependent variable which is included as an additional regressor in the estimation model using an F test. If the null hypothesis of appropriate model specification is rejected, it implies that the original model is likely to be inadequate and thus can be improved. In both the baseline and the extended models, the RESET test only fails to pass for three sectors, namely *Electricity, gas and water supply*, and *Community, social and personal services* at the 1% level of significance, and fails for *Transport, storage and communications* at the 5% level of significance. This suggests that the current model specifications are adequate to explain the determination of real profits for virtually all sectors and multi-sector aggregates, with the exception of the above three sectors, for which, the estimation results should be viewed with caution.

4.3.6. AR (1) Tests

Since panel data have the properties of both time-series and cross-section data, autocorrelation of the error terms within cross-sectional units is a common problem. Even though the robust clustered-by-country estimator used in this study assumes that the error terms are unclustered across countries, it also assumes that the errors are clustered over time within each country. As a result, the autocorrelation problem is still a concern of this study. The AR (1) test is hence adopted. [17]

Fortunately, for all 13 sectors and multi-sector aggregates in both the baseline and extended models, the AR (1) test only fails for *Community, social and personal services* at the 5% significance level. At the 1% level of significance, the null hypothesis cannot be rejected for any sector or aggregate. These results imply that autocorrelation is not likely to be a big problem in the analysis.

[17] The AR (1) test employed is a t-test with the null hypothesis of serially uncorrelated errors against the alternative of serially correlated errors. This test is carried out by regressing the estimated residual obtained from the preliminary regression on the lagged residual and then testing for the significance of the estimated lagged residual, i.e., if the error term follows an AR(1) process,

$$e_{ict} = \rho e_{ic,t-1} + u_{ict}$$

where e_{ict} and $e_{ic,t-1}$ are respectively the estimated residual obtained from equation (1.10) and its first-lagged value, and u_{ict} is a well-behaved error term with mean zero and constant variance. This is a test of the null of $\rho = 0$ against the alternative of $\rho \neq 0$ (Baum, 2006, pp. 156).

4.3.7. Tests for Robustness

To test for robustness of the results, the baseline model is re-estimated for the nine sectors that comprise the total economy by including, respectively, exchange rate volatility and the real long-term interest rate as an additional explanatory variable.

For firms that export to foreign markets, exchange rate volatility determines their choice of currency in which the exports are priced and, in turn, the degree of exchange rate pass-through into the export prices (Devereux et al., 2004). A volatile exchange rate can also complicate the investment decisions of firms that are internationally engaged by limiting their ability to evaluate the present value of future profits and the marginal benefits of new capital goods with high import content (Atella et al., 2003; Chowdhury and Wheeler, 2008). There is an extensive literature investigating the link between exchange rate volatility and investment. In general, exchange rate volatility is found to have a negative impact on investment (e.g., Campa (1993); Atella et al. (2003); Byrne and Davis (2005b); Bhandari and Upadhyaya (2010)), although, zero or even positive effects are also observed in some studies. For example, Goldberg (1993) finds that exchange rate variability tended to expand domestic investment in manufacturing durables sectors in the 1970s, and had negative but quantitatively-small impacts in the 1980s. Darby et al. (1999) argue that the situation in which increasing exchange rate uncertainty depresses investment may or may not happen. Even though exchange rate volatility is found to have an important (negative) effect on investment, this effect is relatively small.

Exchange rate volatility is measured by the weighted standard deviation of the 8-quarter difference in the log of the nominal effective exchange rate, the data for which is obtained from the OECD *Economic Outlook Statistics and Projections* database. Although, in the previous literature, exchange rate volatility generally has negative influences on investment, our estimation results show that, when there is a significant effect of exchange rate volatility on real profits, the effect is always positive, although quantitatively small.[18] In other words, higher exchange rate volatility is associated with higher profit growth. Particularly, positive and significant impacts on real profits of

[18] The estimation results are not reported since only two sectors show significant profit responses to exchange rate volatility.

exchange rate volatility are only found for two sectors, namely, *Manufacturing*, and *Wholesale and retail trade; Restaurants and hotels*, in both the short and the long run. The effects are very weak in the short run, with a profit increase of about 0.01 percent associated with a one percent rise in exchange volatility, and are only significant at the 10% level. In the long run, however, the profit responses to exchange rate volatility increase by more than ten folds than in the short run, and are significant at the 1% level.[19]

Robustness of the results is also tested by including the real long-term interest rate, which proxies the real borrowing cost of capital, as an additional explanatory variable in the regression[20]. The real long-term interest rate is calculated as the nominal long-term interest rate less the lagged rate of inflation. Since real profits are expected to drop as the cost of borrowing and funding new investment rises with a higher real interest rate, there should be a negative relationship between the real long-term interest rate and real profits. According to the estimation results, the real long-term interest rate only significantly and inversely affects the real profits of *Construction* in both the short and the long run.[21]

When exchange rate volatility or the real long-term interest rate is included in the regression, the estimated coefficients on the other explanatory variables and the RESET and AR (1) test results are hardly affected relative to the baseline case.

4.3.8. Endogeneity tests

An augmented Durbin-Wu-Hausman (DWH) test proposed by Davidson and MacKinnon (1993) is used to test for endogeneity of the real exchange rate, real wage, and real GDP. If an explanatory variable is truly exogenous, then the OLS estimator is preferred over the IV estimator, since it is unbiased and efficient. On the contrary, if the regressor is correlated with the error term, then the IV estimator, which is biased and less efficient, will still be consistent while the OLS estimator is not. Moreover, in the

[19] To be specific, the estimated coefficients on exchange rate volatility are 0.013 and 0.16 for *Manufacturing* in the short and the long run, respectively; and the coefficients for *Wholesale and retail trade; Restaurants and hotels* are 0.011 and 0.213, respectively.

[20] The estimation results are quite similar to the baseline case and hence are not reported.

[21] The estimated coefficients on the real long-term interest rate are, respectively, -1.006 and -3.348 for *Construction* in the short and the long run, both significant at the 1% level.

presence of endogeneity, hypothesis tests can be misleading. The test for endogeneity is conducted by regressing the variable that is suspected to be endogenous on its lags (as instrumental variables) and all the exogenous variables. Next, the residual (or the predicted value) from this regression is included as an additional explanatory variable in the original model, and its significance is tested using a standard t-test.

The test results reported in Table 1.3 show that the null hypothesis of the real exchange rate and the real wage being exogenous cannot be rejected for any sector or multi-sector aggregate at the 5% level of significance. The endogeneity test for real GDP fails at the 5% level for *Electricity, gas and water supply*, *Construction*, and *Non-agriculture business sector*, and passes for all sectors but *Construction* at the 1% level of significance. Therefore, for those sectors for which the endogeneity test fails, only the IV estimator will be consistent. For an instrumental variable to be valid, two properties must be satisfied: it must be highly correlated with the included endogenous variable but uncorrelated with the error term (Baum, 2006). Nevertheless, it is difficult to find instruments that are able to meet both requirements. Moreover, if the excluded instruments are only weakly correlated with the endogenous variables, the use of the IV estimator may suffer from the "weak instruments", or "weak identification", problem: (1) the standard errors on IV estimates are likely to be very large, (2) the IV estimates can be inconsistent even when the instruments and the error term in the original equation are only weakly correlated, (3) IV estimates are biased in the same direction as OLS in finite samples, and (4) with weak instruments, testing of significance are likely to have incorrect size, and the confidence intervals are wrong (Bound, Jaeger, and Baker, 1993; 1995). Hence, when the potential instruments are only weakly correlated with the included endogenous variable, as pointed out by Bound et al. (1993), "the cure can be worse than the disease."

However, according to Pesaran et al. (2001), under the ARDL-ECM framework, the parameter estimates produced by OLS can be both unbiased and consistent, and the t-statistics are valid, as long as the lag structure of the model is identified, even when some of the regressors are endogenous (Harris and Sollis, 2003). As a consequence, the endogeneity of real GDP should not be a big concern, given the advantage of the ARDL-based approach.

4.4. The Manufacturing Sector as an Example

Although the manufacturing industries in the OECD countries are no longer at the centre of the world's most recent economic thrust[22], and the average share of manufacturing in total output is less than 20% for the 20 sample countries, manufacturing goods still account for large proportions in both imports and exports. Figure 1.1 depicts how the sample counties' average shares of manufacturing goods in total imports and exports of goods and services change over the period 1970-2008.The figure shows that manufacturing goods account for over 55 percent of both total exports and imports for the entire sample period. Moreover, in the late 1980s and early and late 1990s, the average share of manufacturing in total imports went up to as high as 67 percent, while the average export share reached approximately 63 percent in the late 1990s as well, making the share of *Manufacturing* in total international trade roughly 65 percent. However, all three shares declined gradually in the early 2000s but slightly picked up later.

Equation (1.10) is estimated for the 10 manufacturing subsectors and the results are reported in Tables 1.4 to 1.5, as well as in Tables 3.14 (C) and 3.15 (C), which show the adjusted exchange rate coefficients. According to the PSS t-test results, a long-run relationship between real profits and explanatory variables exists for nine subsectors and may or may not exist for *Chemical, rubber, plastics and fuel products* at the 5% level of significance. At the 10% significance level, however, a level relationship between the dependent and explanatory variables exists for all ten subsectors.

The baseline results, which are reported in Table 1.4, show that, among all 10 subsectors of *Manufacturing*, the exchange rate coefficients are generally positive, with five being significant in the short run (including lagged exchange rate effects) and three in the long run. The real profits of *Basic metals and fabricated metal products* and *Textiles, textile products, leather and footwear* show the largest responses to real exchange rate variations in the short and the long run, respectively. In particular, a one percent real currency depreciation is associated with a short-run profit increase of 1.057 (= 1.67*0.633) percent for the former, and a long-run profit increase of 2.256

[22] This statement comes from Chapter 2: Canadian Manufacturing Sector Trends and Challenges, *The Standing Committee on Industry, Science and Technology*, the Fifth report.

(=3.564*0.633) percent for the latter. Moreover, for all three subsectors whose real profits are significantly responsive to real exchange rate movements in both the short and the long run, namely, *Textiles, textile products, leather and footwear*, *Chemical, rubber, plastics and fuel products*, and *Basic metals and fabricated metal products*, the exchange rate impacts all tend to be stronger in the long run than in the short run.

Hence, the conclusion that the real exchange rate tends to positively affect the real profits of the tradable-good sectors still appears to hold here. However, the subsector *Machinery and equipment* which has the largest trade share (and also the largest export share in production and import penetration ratio) among the manufacturing subsectors, only shows an insignificant profit response to the real exchange rate. By careful examining the subsectors with significant exchange rate coefficients, I find that the real exchange rate tends to significantly influence the real profits of those subsectors in which commodities are produced and thus are likely to be more competitive, such as *Textiles, textile products, leather and footwear*, *Chemical, rubber, plastics and fuel products*, and *Basic metals and fabricated metal products*. In addition, the results also suggest that the non-durable-goods industries tend to be more widely affected by exchange rate changes than do the durable-goods industries in both the short and the long run. To be specific, among the five subsectors that show significant responses, three are non-durable-goods industries[23], including *Textiles, textile products, leather and footwear*, *Pulp, paper, paper products, printing and publishing*, and *Chemical, rubber, plastics and fuel products*, and the other two are durable-goods industries[24], including *Wood and products of wood and cork*, and *Basic metals and fabricated metal products*. In the long run, two non-durable-goods industries still exhibit significant profit responses to real exchange rate movements, while the number of durable goods industries drops to only one. However, we must also note that the durable-goods industries appear to show much stronger short-run responses of profits

[23] The non-durable goods industries include *Food products, beverages and tobacco*, *Textiles, textile products, leather and footwear*, *Pulp, paper, paper products, printing and publishing*, *Chemical, rubber, plastics and fuel products*, and *Manufacturing nec.; Recycling*.
[24] The durable goods industries include *Wood and products of wood and cork*, *Other non-metallic mineral products*, *Basic metals and fabricated metal products*, *Machinery and equipment*, and *Transport equipment*.

to real exchange rate variations than the non-durable-goods industries, whereas the conclusion seems to be rather ambiguous in the long run.

The finding of a significant and positive relationship between real profits and the real exchange rate for half of the subsectors of *Manufacturing* is consistent with the results in Hung (1992-1993) and Clarida (1997) that the appreciation of the dollar reduces manufacturing profits, while a depreciation of the dollar boosts profits. However, given that the profit is a key determinant in a firm's investment decision making process, our finding of positive and significant impacts on real profits of the real exchange rate for most of the manufacturing subsectors and for *Manufacturing* itself seems to contrast with the results in Goldberg (1993)[25] and Campa and Goldberg (1999)[26] who find a negative link between the real exchange rate and investment, and with those in Landon and Smith (2008), who find zero exchange effect in the *Manufacturing* sector.

There are several possible reasons for this. First, the increased shareholder influence on firms' management decisions may depress investment, but stimulate profits, leading to a deviation of profits from the direction of investment growth (Stockhammer, 2005-2006; van Treeck, 2008). Second, the factors that impact profits, such as the exchange rate, may have different effects on investment. Moreover, these effects may change over time. As argued in Goldberg (1993), domestic investment can be affected by the exchange rate through three channels, namely the demand channel, the production channel, and the portfolio and wealth channel. The net effect of the exchange rate on investment depends on the relative strength of these three channels. Hence, if the income and portfolio/wealth effects of the exchange rate on investment dominate the conventional demand effect (for traded goods) and the production effects,

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[25] Goldberg (1993) examines the exchange rate's effect on investment for 31 sectors of US industry over the period 1970-90. She finds that depreciation (appreciation) of the dollar leads to investment expansions (contractions) in the 1970s. However, in the 1980s, both dollar depreciation and appreciation tend to depress investment. This phenomenon is explained in Campa and Goldberg (1995) that the increased reliance of US industries on imported inputs into production has altered the relationship between investment and the exchange rate.

[26] Campa and Goldberg (1999) study the effects of real exchange rate movements on investment activity of the manufacturing industries in the US, Japan, the UK, and Canada. They find that a 10% dollar depreciation leads to a 1% decrease in investment for US high-markup industries and a 2% decrease for low-markup industries. Also, a 10% yen depreciation is found to result in a 3.3% decrease in the investment rate for low-markup industries.

or if sectors rely heavily on imported inputs but have limited export markets, then currency depreciations can be contractionary, even if their effects on profits may be expansionary. Nucci and Pozzolo (2001) also demonstrate that a currency depreciation tends to have a positive effect on investment through the revenue channel and a negative effect through the cost channel. This also explains the seemingly conflicting findings in Goldberg (1993) that dollar depreciation tended to boost investment in the 1970s, but depressed investment in the 1980s. Third, the different structures and degrees of competitiveness across sectors may also contribute to the deviation of profits from investment. As a consequence, our finding of a positive link between the exchange rate and profits may still be consistent with the findings of a negative or zero exchange rate-investment relationship in the previous literature.

The estimation results of the extended model with export orientation and import penetration (Tables 1.5 and 3.15 (C)) show that the real exchange rate can have an impact on real profits through any of the three channels, i.e., the export, import and residual channels. Even though the exchange rate effects through these three channels are found to be either positive or negative or even insignificant individually, the joint effects turn out to be positive and significant for the same subsectors as in the baseline case. Hence, the results from both the baseline and extended models suggest that a real currency depreciation tends to raise real profits for half of the manufacturing subsectors. Moreover, the magnitudes of the exchange rate effects after adjusting for the trade shares are very close to each other in both the baseline and extended models. This implies that the real exchange rate impacts on real profits through the three channels tend to offset each other in the aggregation process.

Real wages are found to significantly and inversely affect the real profits of three out of the ten manufacturing subsectors in the short run and of only one in the long run (and merely at the 10% level of significance). These results are thus consistent with the finding in the previous section that real wages only have significant short-run impacts on the *Manufacturing* profits. Real GDP still has significant, positive and strong impacts on real profits for nine subsectors in the short run, with the only exception of *Food products, beverages and tobacco*. Also, in the long run, the importance of real GDP in the determination of real profits declines substantially, and is limited to only three subsectors, with the estimated coefficients of two of them being only significant at the 10% level. This again suggests that the tradable-good sectors will rely less on the domestic market in the long run due to their ability to expand exports and shift production abroad. A RESET test for appropriate model specification passes at the 5% level for five subsectors, and at the 1% level for seven in the baseline model, whereas the number of subsectors for which the RESET test fails (at either the 5% or 1% level) drops to four in the extended model. The null hypothesis of no autocorrelation cannot be rejected for nine subsectors but *Food products, beverages and tobacco* at the 1% level in both the baseline and extended models. Finally, the null hypothesis of an augmented DWH test for endogeneity that the real exchange rate is exogenous cannot be rejected for any manufacturing subsector (Table 1.3). Moreover, the real wage and real GDP are also confirmed to be exogenous by the same test. As a result, the parameter estimates produced by OLS are both unbiased and consistent.

4.5. Asymmetric Effects of the Exchange Rate

We have shown in previous sections that sectors with different market structures and degrees of openness may respond differently to exchange rate movements. For a particular sector, however, a real currency depreciation and a real appreciation of the same magnitude may not necessarily affect profits to the same extent (in absolute value), but rather have asymmetric effects. For example, a one percent real currency depreciation may lead to a one percent real profit increase for a specific sector, but a real appreciation of the same magnitude may depress the profits of the same sector by more or less than one percent. According to Clarida (1997), the real appreciation of the US dollar in the early 1980s (1980:3-1985:2) reduced the real profits of the manufacturing industry by at least 20%, while the dollar depreciation in the late 1980s (1985:3-1989:2) raised real manufacturing profits by more than 30%.

Such asymmetric responses of profits to exchange rate movements may be attributable to the asymmetric pricing-to-market behavior of the exporting firms when they attempt to build market share, or face capacity constraints and quantitative restrictions (Knetter, 1994). Under a domestic currency appreciation, the exporting firms tend to keep their foreign-currency export price constant, but lower their price-over-cost markups, so as to avoid the loss of price competitiveness and market share in the foreign market. By contrast, in the case of a domestic currency depreciation, the exporting firms may choose to maintain their current profit margins by lowering their foreign-currency price of exports one for one with the depreciation (Froot and Klemperer, 1989; Knetter, 1989; Marston, 1990; Goldberg, 1995). As a consequence, the real profits of the exporting firms are likely to fall in the short run following a real currency appreciation, but may keep unchanged after a real currency depreciation, provided that the amount of exports is fixed in the short run and cannot increase immediately in response to higher foreign demand caused by lower export prices. In the long run, however, as the capacity of production in the domestic country rises to meet the higher foreign demand, exports expand, and real profits of firms tend to increase. Thus, real profits are more likely to show symmetric responses to real exchange rate variations in the long run than in the short run.

To test this hypothesis, a dummy variable *D*, which takes a value of 0 in the case of a domestic currency depreciation (i.e., $\Delta\left(e+p^f-p\right)_c>0$), and a value of 1 otherwise, is generated. Next, the dummy variable *D* is interacted with the trade-weighted real exchange rate, and both *D* and the dummy-interacted real exchange rate are then include as additional explanatory variables in equation (1.10), which will now look as follows:

$$\begin{aligned}\Delta(\pi_i-p)_{ct}=&(\tau_i-1)(\pi_i-p)_{c,t-1}+\delta_i^{'}X_{c,t-1}+\sum_{j=1}^{s-1}\lambda_{ij}\Delta(\pi_i-p)_{c,t-j}+\beta_{i0}^{'}\Delta X_{ct}\\&+\sum_{l=1}^{q-1}\psi_{il}^{'}\Delta X_{c,t-l}+\delta_{i5}D\cdot\left(e+p^f-p\right)_{c,t-1}+\psi_{i5}D\cdot\Delta\left(e+p^f-p\right)_{ct}\\&+\alpha D+\eta_{ic}+\theta_{it}+\varepsilon_{ict}\end{aligned}\qquad(1.11)$$

Then, I test the hypothesis that $\delta_{i5}=\psi_{i5}=\alpha=0$. The results for this test are reported in Table 1.6. Note that the estimated coefficients on the real exchange rate must be multiplied by the average trade share, 0.633, to separate out the exchange rate impacts on real profits. According to the test results, the short-run dummy-interacted real exchange rate, $D\cdot\Delta\left(e+p^f-p\right)$, has significant impacts on real profits for two sectors at the 5% level of significance, namely, *Manufacturing* and *Construction*, and at the 10% level for three sectors and aggregates. Particularly, for *Manufacturing*, a one percent real currency depreciation is found to raise the real profits by 0.648 (= 1.024*0.633) percent, which is slightly higher than the drop in real profits (0.642 percent = (1.024-0.01)*0.633) caused by a real currency appreciation of the same magnitude. By contrast, a real currency depreciation also lowers the real profits of *Construction* by a little more than a real currency appreciation raises them. In the long run, asymmetric exchange rate impacts are only observed for two sectors and aggregates, and only at the 10% significance level.

Among the ten manufacturing subsectors, exchange rate movements are found to asymmetrically affect real profits for *Food products, beverages and tobacco*, *Wood and products of wood and cork*, and *Basic metals and fabricated metal products* in the short run, and for *Food products, beverages and tobacco*, and *Basic metals and fabricated metal products* in the long run. Moreover, in all five cases, the real profits show relatively weaker (absolute) responses to a real currency appreciation than to a real currency depreciation, especially in the short run.

Finally, a joint test of zero coefficients on all three dummy variables suggests that asymmetric effects exist in two sectors, namely *Agriculture, hunting, forestry and fishing*, and *Manufacturing* at the 5% significance level and in another five sectors and subsectors at the 10% level.

Generally speaking, most of the sectors are symmetrically affected by exchange rate variations. The magnitude of asymmetry, whenever exists, is typically very small, especially in the short run. Moreover, the fact that more sectors respond asymmetrically to the real exchange rate in the short run than that in the long run confirms our prediction that real exchange rate variations are more likely to have asymmetric effects on real profits in the short run than in the long run.

4.6. Regional Disparity of Exchange Rate Impacts

Exchange rate fluctuations are an important source of risk for firms that are internationally involved, especially multinationals. When the domestic currency appreciates, firms may choose to either pass through the exchange rate variation into their export prices in foreign currency terms, or to stabilize their foreign-currency export prices by cutting their price-over-cost markups. Also, firms from different countries may take different actions in response to an exchange rate shock. Evidence from previous studies suggests that Japanese firms are more likely to lower their yen export prices and only partially raise their dollar export prices, thus resulting in an incomplete exchange rate pass-through and also a smaller profit margin (Giovannini, 1988; Branson and Love, 1988; Marston, 1990; Knetter, 1993; Toshiko, 1997). German firms also tend to use local-currency-pricing (LCP) on exports to a variety of destinations, especially to the US market (Knetter, 1989, 1993), but to a lesser extent than Japanese firms (Toshiko, 1997). There is, however, little or no evidence of pricing-to-market for US exporters (Mann, 1986; Knetter, 1989, 1993).

One of the most noticeable features of our study is that, among the 20 sample countries, 14 are members of the European Union (EU), among which, 11 also belong to the euro-zone[27]. Thus, due to the closeness of their geographical locations, similar business culture, and common trade policies as a customs union, one may expect firms from the EU countries to adopt similar pricing strategies in export markets and, hence, the exchange rate effects on the real profits of firms from the EU and non-EU countries to be somewhat different.

To test for whether the real profits of firms from the EU and non-EU countries show different responses to real exchange rate movements, I generate a dummy variable EU , which takes the value of 1 if the country is a EU member, and the value of 0, otherwise. This dummy variable is interacted with the trade-weighted real exchange rate, and then included in the model as an additional explanatory variable. Therefore, for the six non-EU countries, which include Australia, Canada, Japan, New Zealand, Norway, and the US, the exchange rate-profit relationship is simply captured by the estimated coefficients on the real exchange rate alone. Whereas for the EU countries, the exchange rate impacts are equal to the estimated exchange rate coefficients plus the estimated coefficients on the dummy-interacted real exchange rate. The test results are reported in Table 1.7.

[27] Norway is a European country, but is not a member of either the European Union or the euro-zone, so it is classified as a non-EU country.

According to the test results, the responses of real profits to real exchange rate movements are not significantly different between firms from the EU and non-EU countries in the short run. In the long run, a real exchange rate shock is found to have significantly different impacts on the real profits of EU firms in the subsector *Manufacturing nec.; Recycling* only at the 5% level of significance, and also in another two sectors at the 10% significance level. In particular, the real profits of the EU firms drop by 1.179 (= (-6.131+4.268)*0.633) percent as the domestic currency depreciates by one percent, whereas the profits of the non-EU firms rise by 2.702 (= 4.268*0.633) percent in response to the same currency depreciation. This may imply that firms from the EU countries in this subsector rely more heavily on imported intermediate inputs than do firms from the non-EU countries. As a result, a real currency depreciation considerably lifts their marginal cost of production and, hence, depresses the real profits for the EU firms, given that this subsector has quite limited export markets due to its small degree of external orientation.

5. Conclusion

In this chapter, I examine the relationship between real profits and the real exchange rate for a sample of nine sectors that comprise the total economy, four multi-sector aggregates, including *Total economy*, and ten manufacturing subsectors for 20 OECD countries during the period 1971-2008.

Since exchange rates may have both a short-run and a long-run impact on the real profits of a particular sector, the ARDL-ECM approach proposed by Pesaran et al. (2001) is adopted to examine both the short and the long-run impacts on sectoral real profits of the real exchange rate. Also, in this study, the trade-weighted real exchange rate, which takes into account the different degrees of external orientation of each of the 20 sample countries, is adopted.

The estimated exchange rate coefficients at the sector level exhibit three important features: firstly, the real exchange rate positively affects the real profits of two out of the three tradable-good sectors, namely *Agriculture, hunting, forestry and fishing*, and *Manufacturing*, and negatively affects the real profits of the non-tradable-good sector *Construction*. Thus, as the domestic currency depreciates, the tradable-good sectors are more likely to gain, while the non-tradable good sectors are more likely to experience a profit loss. Secondly, the real profits of the service sectors in total, namely, *Business sector services*, and *Total services*, are significantly and positively responsive to real exchange rate variations in the short run. As for individual sectors, only *Wholesale and retail trade; Restaurants and hotels*, and *Finance, insurance, real estate and business services* show positive and significant (only at the 10% level) responses of profits to real exchange rate movements. The positive exchange rate effects on the service sectors may be attributable to the increase in service trade over the past 40 years, which may have raised the degree of external orientation for particular service sectors as well as the service sectors as a whole. Finally, the impacts of the real exchange rate on real profits tend to be stronger in the long run than in the short run. This may be explained by the facts that short-run exchange rate exposure can usually be more effectively hedged than can their long-run counterparts (Dohring, 2008) and that firms are more capable of adjusting their production capacity in the long run than in the short run to meet the varying demand in export markets.

For the manufacturing subsectors, the real profits of five are significantly and positively affected by the real exchange rate, and three important features can also be observed. Firstly, significant exchange rate effects tend to occur in those subsectors in which commodities are produced and hence are likely to be more competitive, including *Textiles, textile products, leather and footwear*, *Chemical, rubber, plastics and fuel products*, and *Basic metals and fabricated metal products*. Secondly, the real profits of the non-durable-goods industries tend to be more widely affected by real exchange rate movements than do those of the durable-goods industries in both the short and the long run. Finally, the exchange rate impacts tend to be relatively stronger on the real profits of the durable-goods industries than on those of the non-durable-goods industries in the short run.

A test for asymmetric exchange rate effects on profits show that a real currency depreciation and an appreciation of the same magnitude does affect the real profits of particular sectors asymmetrically, especially in the short run. However, the magnitude of asymmetry is usually very small, but is likely to increase in the long run.

We also test for whether firms from different regions tend to adjust their profits differently in response to real exchange rate variations. The results show that firms from EU countries generally behave in the same manner as firms from non-EU countries. However, they do show significantly different and weaker responses of profits to real exchange rate variations in the subsector *Manufacturing nec.; Recycling* in the long run.

There are some policy implications from this study. Firstly, the exchange rate is found to have a greater and more significant effect on the sectors that have higher degrees of openness, especially the *Manufacturing* sector, which has short- and long-run exchange rate parameters of 0.541 and 1.498, respectively. This implies that a one percent decline in the value of the domestic currency boosts the real profits in this sector by 0.541 percent and 1.498 percent respectively in the short and the long run. Alternatively, this also means that a one percent real currency appreciation will lead to real profit losses as high as 0.541 percent and 1.498 percent in these two periods. Such large drops in the real profits, especially in the long run, could substantially hurt both investment and output in the *Manufacturing* sector, which accounts for over 60 percent of total international trade in goods and services.[28] Moreover, if the home country relies heavily on international trade, this could further affect total output and employment.

Secondly, although a real depreciation of the domestic currency tends to raise the cost of intermediate inputs for all non-tradable-good sectors, which can hardly be offset through export expansions or reduced domestic competition as in tradable-good sectors, none of them, except *Construction*, have experienced significant drops in real profits that are associated with a real currency depreciation. Hence, *Construction* can be thought of as the biggest loser of a currency depreciation. Even though it only accounts for 5.18 percent of total GDP, given its sensitivity to monetary (due to the negative profit-interest rate relationship) and exchange rate policies, it should be given more attention by policy makers.

For future research, how the markups over costs are affected by exchange rate variations may deserve more attention. In the face of exchange rate changes, firms can either adjust their output or the price-over-cost markups in order to stabilize their

[28] See section 4.4 for details.

export prices in foreign currency terms. Hence, either the exchange rate's effect on output or its effects on markups can be an interesting direction of research.

Chapter 2. Effects of the Exchange Rate on Value added

1. Introduction

There are typically two ways for firms to respond to real exchange rate variations: they can either adjust their foreign-currency export prices (assuming local-currency-pricing), so as to pass through part or all of the exchange rate movements into the prices of their products in the export markets. In this case, the quantity of exports and, in turn, domestic output will be affected due to increases or decreases in foreign demand associated with changes in the relative price. Alternatively, they can adjust their price-over-cost markups in the foreign markets in order to stabilize their export prices denominated in foreign currency, or, in other words, price to market. The quantity of exports and domestic output may stay unchanged in this case, but the real profits in domestic currency terms will fluctuate with changes in the exchange rate. Hence, under these two circumstances, exchange rate fluctuations will be borne primarily by output and profit margins, respectively (Branson and Marston, 1989). Also, firms may use any combinations of these two strategies, so that exchange rate variations will have an influence on both output and profit margins. There is evidence in the existing literature that, in response to exchange rate movements, Japanese firms are more willing to do markup adjustments in order to maintain their competitiveness in foreign markets and reduce the influences of exchange rates on their output, while US manufacturers tend to allow their output and employment to fluctuate (e.g., Branson and Love, 1988; Branson and Marston, 1989). Now that the effects of exchange rate variations on profits have been investigated in Chapter 1, this chapter will focus on the influence on output of exchange rates.

Instead of studying only how the total real value added, or total real GDP, of an economy is affected by the real exchange rate, the emphasis of this chapter will be put on the different responses to real exchange rate movements of real value added at both the sector and aggregate levels.

The reason why the exchange rate impacts on sectoral value added, rather than on production, which is under the direct control of firms, are the focus of this chapter is as follows. In the *OECD STAN Database for Industrial Analysis*, production is defined as "the value of goods and/or services produced in a year, whether sold or stocked"[29]. The problem is that, since the consumption of intermediate inputs (including energy, materials, and services) in the process of production is also included in this variable, and any output of intermediate goods that are consumed within the same sector is also recorded as output, the value of total output of a sector is likely to be double-counted. Moreover, the larger the coverage of a sector, the more likely that output will be repeatedly recorded and, therefore, artificially magnified. For this reason, consumption of any intermediate inputs in the production process should be deducted from total production in order to eliminate the possibility of double counting. Hence, value-added can be supported as a better measure of output, and a better indicator of what a sector contributes to overall economic activity.

In previous studies, attention is typically focused on how exchange rate movements affect total GDP or the output of a particular sector, usually manufacturing. Since differences in such factors as degrees of openness, product differentiation, and the competitive structure of markets can significantly affect the responses of each sector's value added to exchange rate variations, and these differences may offset each other and become unobvious when the economy is viewed as a whole, it will be more helpful to investigate the exchange rate impacts on value added at the sector than at the aggregate level. In this chapter, both the short- and the long-run relationships between the real exchange rate and real value added are investigated using the ARDL-ECM approach for 13 sectors and multi-sector aggregates, including both tradable- and non-tradable-good sectors, and ten manufacturing subsectors for 20 OECD countries during the period 1971-2008. To my knowledge, no previous studies have examined the value added-exchange rate relationship for both tradable- and non-tradable-good sectors, and for such a large sample of countries. The only exception might be Hahn (2007), who investigates how sectoral value added responds to exchange rate shocks in

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[29] Definition of *Production* (*Gross output*) from the "Variable definitions" section (Section 2.2) of an introduction of the OECD STAN Database for Industrial Analysis (February, 2005).

the euro area, but the VAR framework and the nominal exchange rates used in his study distinguish it from mine.

We begin in Section 2 by reviewing some recent literature on the impacts of exchange rate variations on both aggregate and sectoral output. Note that output and value added are the same for an economy as a whole, but are different for individual sectors and industries. For a sector or an industry, output, or production, is equal to value added plus consumption of intermediate inputs. However, since studies on the relationship between the exchange rate and sectoral/industrial value added are scarce, the literature on the exchange rate impacts on sectoral/industrial output is reviewed, and may serve as some reference for the findings of this current study.

The theoretical model is presented in Section 3, and the corresponding empirical model is constructed and estimated using the panel ARDL-ECM approach in Section 4. Section 5 concludes this chapter.

Note that in order to separate the effect on value added volume of real exchange rate variations from their impacts on changes in relative prices, in the main text of this chapter, I estimate the responses of the value added volume of each sector to the real exchange rate, and then report the estimation results for real value added (i.e., value added volume times relative prices) in Appendix G. To preview the results, the real exchange rate has both expansionary and contractionary effects on sectoral value added volumes. In particular, the value added volumes of the tradable-good sectors, including *Agriculture, hunting, forestry and fishing*, and *Manufacturing*, and four of the manufacturing subsectors, increase as the domestic currency depreciates. In contrast, the value added volumes of three non-tradable-good sectors, namely, *Electricity, gas and water supply*, *Construction*, and *Community, social and personal services*, show negative responses to a real currency depreciation. For *Total economy*, only a minor value added increase in the short run is associated with a real depreciation of the domestic currency. Therefore, by taking into account the impacts on both sectoral and total value added volumes of the real exchange rate, I conclude that a real depreciation of the domestic currency is likely to benefit the tradable-good sectors, and deteriorate or have no significant impact on the non-tradable-good sectors. The gain of the tradable-good sectors tends to be offset by the loss of the non-tradable-good sectors, leading eventually to only minor growth in total real GDP in the short run, and a neutral effect in the long run. Real value added, which is a product of the value added volume and the relative price, tends to respond in a similar fashion to real exchange rate movements as value added volumes.

2. Review of Literature

2.1. Theoretical Research on the Exchange Rate's Effect on Aggregate Output

Currency depreciations are typically used by monetary authorities as a stabilization device or a policy tool for improving the trade balance. The underlying rationale is that, as the domestic currency devalues or depreciates, domestically-produced goods will become relatively cheaper in the world market. As a result, foreign demand for domestic goods will increase, leading to higher exports and production in the devaluing country. Meanwhile, since the currency depreciation also raises the domestic-currency price of imports (including imported intermediate inputs), domestic demand will switch towards the cheaper substitutes in the domestic market (i.e., the expenditure-switching effect), imports from other countries will thus decline. Eventually, either aggregate output in the home country, or the price level, or both will increase. [30] The success of a currency depreciation in improving the trade balance, as argued by Guittian (1976) and Dornbusch (1988), depends largely on switching demand in the proper direction and amount, as well as on how the home country can meet the additional demand by increasing supply.

Nevertheless, it is also likely that employment and output will both fall after a currency depreciation, especially in less developed countries. This is known as the *contractionary devaluation/depreciation* problem, and a number of studies have been devoted to examining the underlying reasons. Edwards (1985) and Bahmani-oskooee and Miteza (2006) summarise the possible reasons why a devaluation or depreciation would lead to a decline in real economic activity. On the demand side, the higher price level caused by a currency devaluation generates a negative real balance effect, which

[30] If there are unemployed resources in the economy, then a devaluation or depreciation can be expected to boost output; otherwise, the price level in the home country will increase (Johnson, 1976; Krugman and Taylor, 1978).

puts downward pressure on aggregate demand and output. This is the so-called expenditure-reducing effect, which could more than offset the traditional expenditure-switching effect, leading to lower aggregate demand and output. Also, if a devaluation or depreciation of the domestic currency reduces the demand for imported capital by raising its cost, domestic investment which relies largely on imported capital will decline, which will, in turn, depress aggregate demand (Bahmani-Oskooee and Miteza, 2006).

In addition, according to the famous Marshall-Lerner condition, a domestic currency depreciation can improve the trade balance (from an initially balanced trade position) only if the sum of the price elasticities of demand for exports and imports is greater than one. However, if this condition is violated, either because the sum of the export and import elasticities is less than one (more likely in the short run), or because the economy starts from an initial trade deficit (Hirschman, 1949), a real currency depreciation may deteriorate the trade balance, reduce national income and cause a decline in aggregate demand. Moreover, the larger the initial trade deficit, the greater the contractionary effect is likely to be (Krugman and Taylor, 1978). Even if the Marshall-Lerner condition is met, the contractionary effect is still likely to occur if money wages lag the price increase, or if the redistribution of income from wage-earners to profit-earners, who have higher marginal propensity to save, leads to over-saving, after a currency devaluation or depreciation (Krugman and Taylor, 1978). Also, in countries with a high level of financial market imperfections[31], the negative exchange rate effect tends to exist and can be magnified if more external capital is required in these countries' specialized industries (Berman and Berthou, 2009).

The contractionary effects of devaluations or depreciations may also stem from the supply side of the economy if the economy relies heavily on imported intermediate inputs and capital, or if the price increase following a currency depreciation raises the domestic interest rate (at which firms borrow for working capital purposes) and wage rate (Upadhyaya and Upadhyaya, 1999; Upadhyaya et al., 2004).

[31] For example, if firms have to borrow in foreign currency or if they are credit-constrained, i.e., if their borrowing capacity is related to their current wealth rather than to the expected future profitability of current projects (Berman and Berthou, 2009).

Recently, McKinnon (2005) argues that the failure of the common presumption that a currency depreciation (appreciation) can improve (worsen) a country's trade balance may arise from the ignorance of the income (absorption) effects of an exchange rate change and focus only on the relative price effects[32]. For example, a currency appreciation tends to reduce the domestic-currency value of a country's foreign assets. Such a negative wealth effect will, in turn, lower domestic consumption and investment. As a consequence, the final effect of a currency appreciation on the trade balance and, eventually, on aggregate output will depend on the relative strength of the income effect (negative) and the relative price effect (uncertain).

To summarize, currency devaluation or depreciation can lead to an increase in both net exports and the cost of production (due to the higher cost of imported inputs). The net effect depends on the magnitude of the demand and supply side factors. If aggregate demand rises, due to higher net exports, by more (less) than the reduction in aggregate supply, due to higher cost of imported inputs, in response to a currency devaluation or depreciation, the devaluation or depreciation is said to be expansionary (contractionary).

2.2. Empirical Research on the Exchange Rate's Effect on Aggregate Output

The influence of exchange rate movements on aggregate output as well as on other real economic variables has been studied extensively in the previous literature (e.g., Hirschman, 1949; Meade, 1951; Diaz-Alejandro, 1963; Cooper, 1971; Guittian, 1976; Dornbusch, 1988; Krugman and Taylor, 1978; Gylfason and Schmid, 1983; Gylfason and Risager, 1984; Edwards, 1985; Serven, 1995; Upadhyaya , 1999; Upadhyaya and Upadhyaya, 1999; Upadhyaya, Mixon and Bhandari, 2004; Hsing, 2006, and Bahmani-Oskooee and Miteza, 2006). However, the empirical results from the literature tend to be mixed. Some studies (e.g., Gylfason and Schmid, 1983) find an expansionary effect of devaluations on the economy, and others (e.g., Gylfason and Risager, 1984) get opposite results. Edwards (1985), who estimates a model that

[32] The relative price effects of an exchange rate change mean that a currency depreciation (appreciation) will lead to a decline (increase) in export prices and an increase (decrease) in import prices. These effects are the focus of the traditional model of the elasticities approach to the balance of trade (McKinnon, 2005).

incorporates the real exchange rate, monetary and fiscal policy variables as well as terms of trade changes as determinants of real output growth for 12 developing countries during 1965-1980, finds that devaluations have a negative short-run effect on output[33], but a neutral long-run effect. Upadhyaya (1999)[34], Upadhyaya, Mixon and Bhandari (2004) and Hsing (2006)[35] separate the effects of nominal and real exchange rate changes on output, and also find a neutral long run effect of exchange rate depreciations on output. Nevertheless, in contrast to Edwards (1985), the short-run impact is found to be expansionary in Upadhyaya et al. (2004). Moreover, all these four studies support the view that exchange rate fluctuations can affect real economic activities through the real balance effect only in the short run, but leave all real variables unchanged in the long run (Gylfason and Schmid, 1983).

Contrary to the finding of neutral long-run effect in those four studies, some researchers observe significant long-run exchange rate effects as well. Serven (1995) removes the unrealistic assumption in standard one-sector open-economy macroeconomic models that capital goods have zero import content and examines the short- and long-run effects of fiscal and external shocks on the economy. He finds that the long-run capital stock and output are negatively correlated with the long-run real exchange rate. Similar results are also discovered by Bahmani-Oskooee and Miteza (2006), who apply panel unit root and panel cointegration techniques to annual data for 42 countries (18 OECD countries and 24 non-OECD countries) and use four estimation methods (i.e., OLS, Least Squares Dummy Variable (LSDV), and a random-effect model estimated by OLS and Maximum Likelihood (ML)) to estimate the model. Their results show that, in the long run, nominal currency devaluations have a contractionary effect on non-OECD countries regardless of model specification, whereas the results tend to be model-specific for OECD countries.

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[33] To be more specific, Edwards (1985) finds that real devaluations generate a small contractionary effect on output growth only in the first year. In the second year, however, the effect turns out to be expansionary.

[34] Upadhyaya (1999) finds that devaluation has a neutral long-run effect on the sample of countries except Pakistan and Thailand, in which devaluation is found instead to have a contractionary long-run impact.

[35] Hsing (2006) examines the impact of depreciation on real output in Poland and finds that both real and nominal depreciations are contractionary in the first quarter and neutral in the long run, but real depreciation is also found to be expansionary in the second quarter.

In summary, as suggested by some authors (Taylor, 1995; Taylor and Taylor, 2004; Taylor and Sarno, 2004; and Bahmani-Oskooee and Kandil, 2007), whether the impact of currency depreciation is expansionary or contractionary depends on such factors as the model specification, the methodology applied in the empirical investigation, the sample selected (i.e., countries or sectors as well as the period in study), the exchange rate measures, and the period considered (short run versus long run). In addition, as pointed out in Bahmani-Oskooee and Miteza (2003), the use of aggregate output in previous studies may suffer from the problem of aggregation bias, which implies that a positive relationship between a currency depreciation and output in one sector may be more than offset by a negative effect in another sector, resulting in either a negative or insignificant finding at the aggregate level.

2.3. Empirical Research on the Exchange Rate's Effect on Sectoral Output

In spite of a large literature devoted to the study of the impact of exchange rate movements on aggregate output, or total GDP, the effect of exchange rate changes on the output or value added of a specific sector or industry tends to be less extensively investigated. Since sectors or industries differ in such factors as the degree of openness (i.e., export share of production, import penetration, and the share of imported inputs in total factor inputs), the degree of product differentiation, the price elasticity of demand, and other factors that affect the competitive structure of the market (Hahn, 2007), their responses to exchange rate fluctuations may differ substantially from one another. Hence, to determine the impact on output of the exchange rate, instead of studying the economy as a whole, it would be more useful to examine how each sector or industry responds to exchange rate shocks.

Branson and Love (1986, 1988) examine the impacts of real exchange rate movements on the employment and output of US and Japanese manufacturing industries. They find that a real currency appreciation has contractionary effects on both manufacturing output and employment, and this effect is particularly significant in durable goods sectors. However, Glick and Hutchison (1990) counter the findings in Branson and Love (1986, 1988), as well as in some other studies, that the dollar appreciation has a contractionary effect on output in US manufacturing industries. They provide evidence that the relationship between the real exchange rate and sectoral output is unstable over time and varies with different macroeconomic disturbances, using US data from 1970 to 1987. As a consequence, a currency appreciation may be associated with either an expansion or a contraction of the manufacturing sector, depending on the nature of the underlying disturbances and policy reactions.

Bahmani-Oskooee and Mirzaie (2000) examine the long-run impact of exchange rate fluctuations on production for eight different sectors (including both tradable- and non-tradable-good sectors) in the US economy by applying Johansen's cointegration technique. They find no evidence of a long-run relationship between the nominal effective exchange rate and sectoral output.

Forbes (2002a) investigates the short- and long-run influences of currency devaluations on firms' output, profitability, capital investment and stock returns, using information for about 1,100 firms in 10 commodity industries during the period 1996-2000. She finds that, a currency devaluation immediately lowers the relative cost of labor in the devaluing countries and, thus, gives a boost to the growth rates of both output and profits. In the long run, however, as the currency devaluation raises the relative cost of capital for firms in the devaluing countries, both output and profits are likely to fall if the firms are capital-intensive and the increase in the cost of capital outweighs the drop in the cost of labor.

Hahn (2007) studies the impact of (nominal) exchange rate shocks on sectoral real value added and prices in the euro area using a VAR framework. His results suggest that exchange rate shocks have substantially heterogeneous effects on the value added of different sectors. In particular, a euro appreciation is found to have a significantly negative impact on the real value added of the industrial sector (excluding construction), and trade and transportation services. Among the main subsectors of the industrial sector (excluding construction), significant exchange rate effects only occur in the manufacturing sector. Moreover, even higher degree of diversity in the responses of production to exchange rate shocks is found among the manufacturing subsectors, with food production showing a zero response and manufacturing of machinery and equipment exhibiting the largest response.

Due to the scarcity of studies on the exchange rate-value added relationship at the sector level, it is difficult to identify the exact pattern of how the exchange rate affects the value added of a particular sector. However, based on the findings of the previous studies, a currency devaluation or deprecation is more likely to have an expansionary effect on manufacturing, and a contractionary effect on the service sectors, which have limited export markets, as well as on those sectors that rely heavily on imported inputs.

This chapter will contribute to the literature by investigating the impacts of real exchange rate variations on real value added at both the aggregate and sector levels for 20 OECD countries during the period 1971-2008. In particular, the exchange rate-value added relationship is examined for not only the *Manufacturing* sector, which has been studied most in-depth in the previous literature, but also for another eight sectors that comprise the total economy, four multi-sector aggregates, and ten manufacturing subsectors. Moreover, the ARDL-ECM approach proposed by Pesaran et al. (2001) will be used to distinguish between the short- and long-run effects of the exchange rate. Hence, this study will fill the gap in the literature by identifying the exact pattern of how the real value added of sectors with different degrees of openness respond to exchange rate shocks in the short and the long run.

3. The Theoretical Model

Following the model in Chapter 1, a representative firm in sector i of the domestic country produces goods at home and sells them both domestically and abroad. The output produced for the domestic and foreign markets are, respectively, $Q_i \text{ and } Q_i^f$, which are functions of the relative prices and real GDP in the home and foreign countries, respectively.

$$Q_i = Q_i\left(\frac{P_i}{P}, Y\right), \;\; \partial Q_i \big/ \partial\left(P_i/P\right) < 0, \quad \partial Q_i/\partial Y > 0 \tag{2.1a}$$

$$Q_i^f = Q_i\left(\frac{P_i^f}{P^f}, Y^f\right), \;\; \partial Q_i^f \Big/ \partial\left(P_i^f/P^f\right) < 0, \quad \partial Q_i^f/\partial Y^f > 0 \tag{2.1b}$$

where P_i, P_i^f = the prices set by the domestic representative for products sold in the domestic and foreign markets, respectively. P_i^f is expressed in the foreign currency.

P, P^f = the general price level in the home and foreign countries, respectively. P^f is expressed in the foreign currency.

Y, Y^f = the real GDP (or real income) in the home and foreign countries, respectively.

The representative firm maximizes profits:

$$\max_{P_i, P_i^f, L_i, M_i} \frac{\Pi_i}{P} = \frac{P_i}{P} Q_i\left(\frac{P_i}{P}, Y\right) + \left(\frac{EP^f}{P}\right)\left(\frac{P_i^f}{P^f}\right) Q_i^f\left(\frac{P_i^f}{P^f}, Y^f\right) - \frac{W}{P} L_i - \left(\frac{EP^f}{P}\right)\left(\frac{P_M^f}{P^f}\right) M_i \tag{2.2}$$

subject to the production function $Q_i + Q_i^f = f\left(L_i, M_i\right)$.

where Π_i/P = the real profits of the representative firm in sector i measured in domestic-currency terms;

E = the nominal exchange rate, which represents the domestic currency price of one unit of foreign currency, and EP^f/P denotes the real exchange rate;

W/P = the real price of the non-tradable domestic inputs, or the real wage, which is assumed to be the same for all firms;

P_M^f = the world price of the imported intermediate inputs, expressed in the foreign currency, where P_M^f is assumed to be determined in the world market;

L_i = the non-tradable domestic input, such as labor, used in the production; and

M_i = the imported intermediate input used in the production.

Solving the profit-maximization problem specified in equation (2.2) and manipulating the solution yields the optimal profit function, Π^*, and the optimal labor demand function, L^*. Substituting these two functions into the definition of value added as the sum of profits and labor compensation yields:

$$\frac{VA_i}{P} = \frac{\Pi_i^*}{P}\left(\frac{EP^f}{P}, \frac{W}{P}, \frac{P_M^f}{P^f}, Y, Y^f\right) + \frac{W}{P} L_i^*\left(\frac{EP^f}{P}, \frac{W}{P}, \frac{P_M^f}{P^f}, Y, Y^f\right) \tag{2.3}$$

Alternatively, equation (2.3) can be written as:

$$\frac{VA_i}{P} = \Gamma_i\left(\frac{EP^f}{P}, \frac{W}{P}, \frac{P_M^f}{P^f}, Y, Y^f\right) \tag{2.4}$$

Variations in the real exchange rate affect both the foreign demand for domestic goods and the cost of imported intermediate inputs in domestic currency terms. In particular, holding all other variables constant, whether the representative firm adopts a full pass-through (i.e., $dP_i^f \big/ d\left(EP^f/P\right) = -1$) or a zero pass-through strategy (i.e., $dP_i^f \big/ d\left(EP^f/P\right) = 0$), its foreign revenue in domestic currency terms and, in turn, total real value added and real profits, will both decline, following a real currency appreciation. This is because, a full pass-through of the real currency appreciation pushes up the relative price of exports in foreign currency terms and, hence, depresses the foreign demand for domestic goods (i.e., the price/volume effect). A zero pass-through, on the contrary, leaves the foreign-currency export prices and foreign demand unaffected, but reduces the foreign revenue measured in the domestic currency as the real exchange rate drops (i.e., the translation effect). When the exchange rate pass-through is incomplete but greater than zero, according to Hung (1992-1993), there is a trade-off between the price/volume effect and the translation effect: a given real currency appreciation will hurt the real value added and real profits more through a loss in the volume of foreign sales but less through a translation of the foreign revenue into domestic currency terms as a larger proportion of the exchange rate variation is passed through into the foreign-currency export price. Meanwhile, as the domestic currency appreciates, the cost of imported intermediate inputs in domestic currency terms, $\left(EP^{f}/P\right)\left(P_{M}^{f}/P^{f}\right)$, and in turn, the marginal cost of production, will decrease, thus giving rise to a higher real value added, other things being equal. As a result, the net effect of the real exchange rate on real value added can be either positive or negative, depending on the relative magnitudes of the real exchange rate impacts through the demand and the cost channels.

Equation (2.3) shows that, other things being equal, there should be a positive relationship between real value added and the real wage[36], given that real value added is the sum of real profits and total real labor compensation. However, since real profits are expected to be inversely related to the real wage, if the drop in real profits outweighs the rise in total real labor compensation, both caused by an increase in the real wage, real value added is likely to fall. In addition, an increase in the real wage is also likely to discourage the demand for labor. Thus, if employment drops as the real wage rises, the relationship between the real wage and real value added can also become ambiguous.

Both the real GDP of the home country, Y, and the foreign real GDP, Y^{f}, are expected to have positive effects on real value added, and also on real profits, due to their positive impacts on domestic and foreign demands, respectively.

For the purpose of estimation, take natural logs on both sides of equation (2.4), and rewrite it as follows:

$$va_{i}-p=\varphi_{i}\left(e+p^{f}-p, y, y^{f}, w-p, p_{M}^{f}-p^{f}\right) \tag{2.5}$$

where the lower case letters represent the natural logarithms of the corresponding upper case variables.

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[36] This is confirmed by the correlation coefficients reported in Table 1. In particular, movements in real value added and those in real wage are positively and significantly correlated in all sectors, with the only exceptions of *Mining and quarrying* (negative and insignificant correlation), and *Chemical, rubber, plastics and fuel products* (positive but insignificant correlation). By calculating the correlation coefficients between changes in real wages and in value added volumes, I also find positive correlations (significant in most cases) between these two variables for all sectors except *Agriculture, hunting, forestry and fishing*.

To capture the different channels through which the exchange rate may affect real value added, following Campa and Goldberg (2001), I construct three sector-specific real exchange rate variables by interacting the real exchange rate with, respectively, sectoral export orientation (x_i), import penetration (m_i), and the use of imported inputs (q_i). After the three transmission channels are taken into account, equation (2.5) becomes:

$$va_i - p = \varphi_i\left(\left(1 + x_i + m_i + q_i\right)\left(e + p^f - p\right), y, y^f, w - p, p_M^f - p^f\right) \qquad (2.5')$$

where x_i = the share of export sales in total revenue, which is used to measure the degree of export orientation of sector i ;

m_i = the import penetration rate of the domestic market;

q_i = the share of imported inputs in total factor inputs.

These three channels capture the sensitivity of real value added to real exchange rate fluctuations. As the domestic currency depreciates, domestic goods will become cheaper in the export markets and demand for domestic goods will increase. Therefore, the larger the share of output that is exported (x_i), the more likely that the representative firm's real value added and real profits will expand through higher foreign revenues. Nevertheless, if the foreign demand for domestic exports is rather inelastic, then the foreign revenue may not change even when the exporting firm passes through the full exchange rate variation into its foreign-currency export price. In this situation, the degree of export orientation may be irrelevant in the determination of the responses of real value added and real profits to exchange rate movements. Import penetration in the domestic market (m_i) can be positively related to or have no significant impact on sectoral value added. When the domestic currency depreciates, or alternatively, when the foreign currency appreciates, the foreign exports to the domestic market will become more expensive. Hence, demand will switch to the cheaper substitutes produced by the domestic representative firm that competes with the foreign exporter directly, and the real value added of the domestic firm will increase accordingly. Moreover, the higher the degree of import penetration, the more the domestic firm's real value added is likely to expand. Nevertheless, if the products produced by the domestic and foreign firms are not perfectly substitutable, or if the foreign representative firm prices to market by absorbing part or all of the exchange rate variation, the sensitivity of real value added of the domestic firm with respect to the exchange rate may be unresponsive to the import penetration ratio. Finally, the more heavily the representative firm relies on imported intermediate inputs in its production (i.e., the higher q_i), the more likely that its real value added will fall as the domestic currency depreciates. Therefore, the exchange rate effect on real value added through the channel of imported inputs is expected to be negative.

4. Empirical Application

To assess the effects of exchange rate movements on sectoral value added, an estimable empirical model based on the theoretical model specified in equation (2.5) must be constructed.

4.1. Data

To study the effects of exchange rate impacts on sectoral value added, I adopt the same 20 OECD countries and the same sample period (1971-2008) as in Chapter 1, given data availability. The variables included in the regression follow the theoretical model which is derived in the previous section. The dependent variable is sectoral real value added, and the explanatory variables include the real exchange rate, the real wage and real GDP.

Instead of defining real value added in the same way as real profits, i.e., dividing nominal value added by the GDP deflator, the value added volume is adopted as the dependent variable in this chapter. This is facilitated by the availability of the series Value added, volumes (VALK) in the OECD STAN Database for Industrial Analysis for all nine sectors, four multi-sector aggregates and 10 subsectors of *Manufacturing*[37]. The main reason for this change is that, a real exchange rate movement can affect both the

[37] Data for value added volumes is not available for Australia, and for certain years for different countries in different sectors.

value added volume and the relative price of a sector. As a consequence, it would be impossible to tell which one is the key driver of the change in real value added, if it is defined as nominal value added divided by the GDP deflator. However, to test for robustness of the estimation results and make the results comparable with those in Chapters 1 and 3, the value added equation is also re-estimated by replacing the value added volume with the real value added, i.e., nominal value added divided by the GDP deflator, as the dependent variable. From this point on, to distinguish between these two value added variables, VALK is called the volume of value added, whereas the nominal value added divided by the GDP deflator is termed the real value added. Data for the nominal value added (VALU) is also obtained from the OECD STAN Database. Table G.1 in Appendix G reports the correlation coefficients between percentage changes in the value added volumes, real value added, the relative prices (i.e., the difference between the percentage changes in real value added and in value added volumes) and the real exchange rate for all sectors. Since the correlation coefficients for a majority of the sectors are significant and greater than 0.5, the two value added measures are highly correlated.

In Table 2.1, the second column in panel (A) shows the size of each sector relative to total GDP, and the second column in panel (B) gives the value added share of each subsector in total *Manufacturing*[38]. It is quite obvious from the table that, among the 20 OECD countries, the service sectors (*Total services*), on average, have the largest share (69.98%) in total value added, followed by the *Manufacturing* sector with a share of only 16.5%. The sectors of *Agriculture, hunting, forestry and fishing* (2.28%), *Mining and quarrying* (2.61%) and *Electricity, gas and water supply* (2.35%) are the smallest sectors, which together account for less than 10% of total GDP. Among the subsectors of *Manufacturing*, the subsector of *Machinery and equipment* tends to have the largest value added share (20.9%) in total manufacturing. It outweighs the subsector of *Chemical, rubber, plastics and fuel products* (15.84%), which follows closely, by more than 5%. The *Wood and products of wood and cork* subsector has the smallest share of 2.65% in total manufacturing.

[38] The value added shares are calculated using the nominal value added variable (VALU), due to the unavailability of volume data for certain countries and years. Similar results can be achieved when value added volumes are used.

The real effective exchange rate (CPI based) data is obtained from the OECD Main Economic Indicators database. As in Chapter 1, the log of the inverse of the real exchange rate is weighted by the average trade share (i.e., exports plus imports) of each country in its total GDP over the period 1970-2008 to take into account the differences in the international involvement of each country. Even though in the extended theoretical model, the real exchange rate is interacted with, respectively, export orientation, import penetration, and the imported input use, due to data availability, only the former two channels are explicitly incorporated in the empirical application. Nevertheless, the impact of the imported input use on sectoral value added can still be captured by the coefficients on the non-interacted real exchange rate. Also, the extended model is estimated for the three tradable-good sectors, *Total services*, *Total economy*, and the ten manufacturing subsectors, for which, exports and imports data are available. For the tradable-good sectors and manufacturing subsectors, sectoral exports and imports data are obtained from the OECD STAN Database, and for *Total services* and *Total economy*, the data are available in the OECD National Accounts and Historical Statistics. In addition, for these sectors, modified versions of sectoral export orientation and import penetration are calculated. To be specific, export orientation is calculated as the share of exports in a sector's value added, and import penetration as sectoral imports divided by (sectoral value added plus imports less exports). Moreover, to take into account the fact that the real exchange rate is significantly correlated with export orientation and/or import penetration for specific sectors, the average export and import shares for each country are used in the regression. Therefore, for the extended model, three exchange rate variables, including the trade-weighted real exchange rate, the (un-weighted) real exchange rate interacted with, respectively, export orientation and import penetration, are included in the regression for the tradable-good sectors, manufacturing subsectors, *Total services*, and *Total economy*. This model has an advantage that, if the estimated coefficients on the two interacted real exchange rate variables are insignificant, the model can be reduced to the baseline model, as long as the lag lengths on all other variables are the same in both cases.

Domestic real GDP (expenditure approach, OECD base year = 2000) is obtained from the OECD National Accounts and Historical Statistics database. Also, since domestic real GDP is virtually identical to the value added volume of *Total economy*, which is equal to the sum of the volumes of value added of all nine sectors that comprise the total economy, the inclusion of total real GDP in the estimation equation as an explanatory variable of sectoral value added volumes may cause an endogeneity problem. To avoid this, we use total real GDP minus the value added volume of the sector in question as the explanatory variable. In addition, for *Total economy*, due to the equivalence of its value added volume and total real GDP by definition, it is inappropriate to use total real GDP as an explanatory variable for real value added. As a consequence, the rate of unemployment as percentage of civilian labor force, obtained from the OECD Economic Indicators Database, is used to capture cyclical fluctuations in aggregate demand (Branson and Love, 1986; Revenga, 1992). Unemployment rate and real GDP are significantly and inversely correlated with each other, with a simple correlation coefficient of -0.459 between the short-run changes of these two variables.

Foreign real GDP, y^f, is assumed to be the same for every sample country in a certain period and hence can be captured by a vector of year dummies, θ_{it}. The price of the imported intermediate inputs, $\left(p_M^f - p^f\right)$, is assumed to be determined in the international market and hence is also the same for all sample countries at each point of time. Thus, due to multicollinearity between this price variable and the vector of year dummies, it is omitted from the regression and has its impact on real profits captured by the year dummies.

4.2. Model Estimation

To examine both the short and long-run effects of exchange rates and the other explanatory variables on sectoral value added, the same ARDL-ECM framework as in Chapter 1 is adopted. Transform equations (2.5) and (2.5') into a general ARDL-error-correction form with lags (s, q) for the dependent and explanatory variables, respectively, where q is allowed to differ across the explanatory variables:

$$\begin{aligned}\Delta\left(va_i - p\right)_{ct} &= \left(\tau_i - 1\right)\left(va_i - p\right)_{c,t-1} + \delta_i' X_{c,t-1} + \sum_{j=1}^{s-1}\lambda_{ij}\Delta\left(va_i - p\right)_{c,t-j} \\ &\quad + \beta_{i0}'\Delta X_{ct} + \sum_{l=1}^{q-1}\psi_{il}'\Delta X_{c,t-l} + \eta_{ic} + \theta_{it} + \varepsilon_{ict}\end{aligned} \tag{2.6}$$

where $X_c = \left[\left(e + p^f - p\right)_c, y_c, \left(w - p\right)_c \right]'$ is a 3×1 vector of explanatory variables in the baseline model (equation (2.5)), and

$X_c = \left[\left(e + p^f - p\right)_c, x_i\left(e + p^f - p\right)_c, m_i\left(e + p^f - p\right)_c, y_c, \left(w - p\right)_c \right]'$ is a 5×1 vector in the extended model for the tradable-good sectors, manufacturing subsectors, *Total services*, and *Total economy* (equation (2.5')), η_{ic} and θ_{it} are the country-specific fixed effects and time effects, respectively. The parameter $\left(\tau_i - 1\right)$ is the error-correction coefficient which measures the speed of adjustment to the long run, λ_i are the coefficients on the lagged differences of the dependent variable, δ_i and ψ_i represent the vectors of coefficients on the lagged levels and lagged differences of the explanatory variables, respectively, and β_{i0} is the vector of coefficients on the first difference of the explanatory variables.

Since the assumption that the error terms are identically and independently distributed may be violated if the errors are conditionally heteroskedastic (Baum, 2006) or if the observations within certain groups are correlated in some unknown way (Nichols and Schaffer, 2007), OLS may not be able to provide consistent estimates of the standard errors. Also, since observations from two different years for the same country usually exhibit more similar features than do observations from the same year for two different countries, it is more reasonable to assume that the error terms are clustered within each country[39], but unclustered across countries. Thus, given the above assumptions, the robust- clustered-by-country estimator is adopted in the estimation. Moreover, due to the relatively small sample size of this study, a maximum of two lags is assigned to each variable (Pesaran, Smith and Akiyama, 1998). Thus, the model is first estimated with two lags for each explanatory variable and the lagged dependent variable. Those lags that are statistically insignificant (at the 10% level) are first dropped through sequential elimination, and the Schwarz Bayesian Criteria (SBC) is then used as a check for the optimal lengths.

[39] If the cluster-by-year estimator is used, the optimal lag lengths and estimated coefficients will still be the same for most sectors, while the standard errors will be slightly smaller.

4.2.1. Error Correction Coefficients

The error-correction coefficient $(\tau_i - 1)$ measures the rate at which the value added volume of a sector approaches its long-run steady-state level. According to the estimation results reported in Table 2.2 (A) through 2.3, the error-correction coefficients in all sectors have the correct sign, i.e., negative. Nevertheless, this does not guarantee the existence of a long-run relationship between the value added volume and the explanatory variables without testing for the significance of the error-correction coefficients. Hence, the *PSS* t-test for level relationships, proposed by Pesaran et al. (2001), is conducted for each sector, and the significance of the error-correction coefficients is determined based on the critical value bounds provided in Pesaran et al. (2001).

In the baseline model, the null hypothesis of no long-run relationship between the dependent and explanatory variables cannot be rejected for two sectors, namely, *Wholesale and retail trade; Restaurants and hotels*, and *Transport, storage and communications*, and two multi-sector aggregates, namely, *Business sectors services*, and *Total services*, at either the 5% or 10% levels of significance, and is only rejected at the 10% level for *Total economy*.

4.2.2. Real Exchange Rate Parameters

4.2.2.1. Baseline Model

To correctly evaluate the influences of real exchange rate movements on the volume of value added, the estimated exchange rate coefficients reported in Tables 2.2 (A) to 2.3, as shown in Chapter 1, have to be multiplied by the average trade share, 0.633. The adjusted exchange rate coefficients are reported in Tables 3.14 (A)-(B) and 3.15 (B)-(C).

Table 2.2 (A) (and Table 3.14 (A)) shows that, among the nine sectors that comprise the total economy, a real currency depreciation is associated with growth in the volumes of value added for two of the three tradable-good sectors, namely, *Agriculture, hunting, forestry and fishing* in the long run, and *Manufacturing* in both the short and the long run. Particularly, for the former sector, a one percent real currency depreciation is found to raise its long-run value added volume by 0.597 (= 0.943*0.633) percent. The same real currency depreciation will cause the *Manufacturing* value added volume to rise by, respectively, 0.222 (= (0.191+0.16)*0.633) and 1.567 (=2.475*0.633) percent in the short and the long run. By contrast, for half of the non-tradable-good sectors, namely, *Electricity, gas and water supply*, *Construction*, and *Community, social and personal services*, falling value added volumes tend to be associated with a real currency depreciation in either time period. The *Construction* sector, in particular, is significantly affected by real exchange rate movements in both the short and the long run, with value added volume falling by 0.193 (=(-0.124-0.181)*0.633) and 0.619 (=-0.978*0.633) percent in the short and the long run, respectively.

According to the theoretical model, the value added volume of a sector can be affected by real exchange rate variations through two channels – the demand channel and the cost channel. As the domestic currency depreciates, on the one hand, domestically-produced goods will become cheaper relative to foreign goods in the export market. Consequently, the demand for and, in turn, the production of domestic goods will increase, leading to higher volumes of value added as well as higher real profits (i.e., the demand channel). On the other hand, a real depreciation of the domestic currency also puts downward pressure on the value added volumes and real profits by pushing up the cost of imported intermediate inputs in domestic currency terms as well as the marginal cost of production (i.e., the cost channel). Therefore, if a sector has a great potential for export expansion as the domestic currency depreciates, and its reliance on imported intermediate inputs is moderate, such as the tradable-good sectors, then a real currency depreciation is more likely to boost the value added volume for that sector. On the contrary, if a sector relies heavily on imported intermediate inputs but has a limited export market, or if real wages decline as a result of the inflationary effect of the real currency depreciation, which then discourages the supply of labor and employment, then the value added volume of that sector is more likely to contract. Therefore, the findings of both positive and negative effects on value added volumes of the real exchange rate are consistent with the predictions of the theoretical model.

Moreover, for the two sectors *Manufacturing* and *Construction*, whose volumes of value added are significantly affected by real exchange rate movements in both the short and the long run, the long-run responses are both notably stronger (in absolute value) than their short-run counterparts. Some of the possible explanations include: (1) Short-run exchange rate exposures, due to their relative predictability, can be more effectively hedged than the long-run exposures, leaving the short-run value added volume and, in turn, real profits less sensitive to the real exchange rate. (2) In the long run, as the contracts negotiated prior to the exchange rate changes have been executed and all costs become flexible, firms will be more capable of adjusting their foreign-currency export prices and production to meet the varying demand in the export markets, which are induced by real exchange rate movements. As a consequence, the larger price and production adjustments in the long run will cause the value added volumes and real profits of these firms to fluctuate more vigorously with the real exchange rate.

Among the four multi-sector aggregates, significant and positive responses of value added volume to real exchange rate variations are observed in both the short and the long run for *Non-agriculture business sector*, and only in the short run for *Total economy* (Table 2.2 (B)). Thus, despite the inclusion of both tradable and non-tradable-good sectors in these two aggregates, the net exchange rate effects are still dominated by the positive responses of the *Manufacturing* sector. Also, for *Non-agriculture business sector*, the exchange rate impact also tends to be stronger in the long run than in the short run. In addition, a comparison of the short-run exchange rate coefficients between these two aggregates show that, a one percent real currency depreciation leads to a greater value added increase for *Non-agriculture business sector* (0.063 (=0.099*0.633) percent) than for *Total economy* (0.034 (=0.053*0.633) percent). Since the sectors *Agriculture, hunting, forestry and fishing*, and *Community, social and personal services* are included in *Total economy* but not in *Non-agriculture business sector*, *Manufacturing* should account for a larger proportion in the latter aggregate and, hence, have a greater influence on its response to exchange rate variations. Finally, for *Total economy*, the exchange-rate-induced minor increase in total real GDP suggests that, if policy makers attempt to use a currency depreciation to stimulate the economy, it may not work as well as expected. Even though the export sectors, including

Manufacturing and *Agriculture, hunting, forestry and fishing*, indeed gain from this depreciation, from the perspective of the economy as a whole, this gain is partly offset by the loss of the non-tradable-good sectors, including *Electricity, gas and water supply*, *Construction*, and *Community, social and personal services*, leaving only mild growth in total GDP in the short run and a neutral impact in the long run. This result also confirms the argument of Bahmani-Oskooee and Miteza (2003) that the use of aggregate output may suffer from the problem of aggregation bias, so that a positive relationship between the exchange rate and output of one sector may be more than offset by a negative effect in another sector, resulting in either a negative or insignificant finding at the aggregate level.

4.2.2.2. Extended Model with Export Orientation and Import Penetration

Export orientation and import penetration are incorporated in the model to take into account the two channels through which the real exchange rate may affect the volumes of value added for the three tradable-good sectors, *Total services*, and *Total economy*. According to the estimation results (Tables 2.3 and 3.15 (B)), a real currency depreciation has a positive and significant impact on the value added volume of *Agriculture, hunting, forestry and fishing* through the import channel in the short run, and through the residual channel in the long run. The net impact, however, is only significant in the long run, with a 0.547 (=1.575*0.633-1.811*0.358+0.522*0.38) percent increase in value added volume associated with a one percent real currency depreciation, consistent with the result of the baseline model. The volume of *Manufacturing* value added is still significantly and positively responsive to total real exchange rate variations in both the short and the long run, although the individual effects are only significant through the import channel. Even though the exchange rate impacts through all three channels all insignificant for *Total economy*, the net effect still turns out to be positive and significant in the short run. Moreover, for all these three sectors and aggregates, the net exchange rate effects are all very similar to the baseline results, implying that the exchange rate effects through the individual channels tend to offset each other.

Real exchange rate movements are found to significantly affect the value added volume of *Mining and quarrying* through the export channel in both the short and the long run and through the import channel only in the long run. In particular, the value added responds inversely to a real currency depreciation through the export channel, and positively through the import channel. The net effect turns out to be a drop of 0.246 (=-0.255*0.633-(0.018+0.022)*2.141) percent in short-run value added volume associated with a one percent real currency depreciation. This negative effect may be largely attributable to the sector's heavy reliance on imported inputs, which is reflected in the negative exchange rate coefficient through the residual channel (-0.161=0.255*0.633). The unexpected negative impact through the export channel apparently accounts for a smaller part (-0.086=-(0.018+0.022)*2.141) of this effect. Such a negative value added response, therefore, establishes *Mining and quarrying* as the only tradable-good sector that experiences output contraction as the domestic currency depreciates. Nevertheless, this finding is not supported by the results from the baseline model, in which, the value added volume of *Mining and quarrying* is insignificantly affected by the real exchange rate in both the short and the long run.

Like real profits, the value added volume of *Total economy* is insignificantly responsive to real exchange rate movements through any individual channel in either time period. The net effect, however, is a small increase of approximately 0.038 (=-0.63*0.633-0.004*6.291+0.371*1.235) percent in short-run real GDP caused by a one percent real depreciation of the domestic currency.

4.2.3. Real GDP and Real Wage Parameters

Real GDP has a significant and positive impact on value added volumes for six sectors and three multi-sector aggregates in the short run (Table 2.2 (A) and (B))[40]. The greatest impacts are observed for the sectors *Construction*, and *Wholesale and retail trade; Restaurants*, with a one percent real GDP growth associated with a 1.636 percent increase in the value added volume of the former and a 1.055 percent increase in the latter. In contrast, the short-run value added volume of *Agriculture, hunting, forestry*

[40] Real GDP is not included in the regression for *Total economy* since the real value added of *Total economy*, by definition, is identical to total real GDP.

and fishing is inversely affected by the real GDP growth, although only at the ten percent significance level.

In the long run, real GDP loses its importance in the determination of value added volume for most of the sectors and all multi-sector aggregates. Among the tradable-good sectors, only the value added volume of *Mining and quarrying* is significantly (at the 10% level) but inversely responsive to real GDP growth. Significant and positive relationships between real GDP and sectoral value added volume still exist for three of the non-tradable-good sectors, namely, *Construction*, *Finance, insurance, real estate and business services*, and *Community, social and personal services*. Moreover, for the *Construction* sector, the long-run effect is relatively weaker than its short-run counterpart, while for the latter two sectors, real GDP gains more importance in the determination of their long-run value added volumes. The asymmetric influences of real GDP on long-run value added volumes for tradable- and non-tradable-good sectors may be explained by the fact that non-tradable-good sectors depend primarily on domestic demand, while tradable-good sectors face demand from both the domestic and foreign markets. In the long run, the tradable-good sectors will be more capable of increasing value added and profits through export expansion or cost reduction (e.g., shifting production overseas, or using cheaper substitutes for the imported intermediate inputs). Consequently, their reliance on the domestic market and the influence of domestic real GDP on their value added volumes should decline in the long run. This argument also applies to the impact on real profits of real GDP studied in the previous chapter.

For *Total economy*, the unemployment rate takes the place of real GDP to capture cyclical fluctuations in aggregate demand. According to the estimation results in Table 2.2 (B), an increase in unemployment has a negative and significant impact on the value added volume of *Total economy*, with a one percent increase in unemployment rate[41] associated with a minor drop of 0.043 percent in total volume of value added, although only in the short run.

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[41] Note that the unemployment rate increases by one percent (for example, from 5% to 5.05%) rather than by one percentage point (i.e., from 5% to 6%). If the level of the unemployment rate,

The real wage of the total economy is found to have both positive and negative effects on sectoral value added volumes. In particular, the long-run value added volume of *Construction* drops as the real wage rises, while the value added volume of *Manufacturing* in the long run and those of *Total services*, and *Total economy* in the short run all respond positively to a real wage increase. Since, according to the theoretical model, real value added is the sum of real profits and total real labor compensation, other things being equal, the volume of value added should be an increasing function of the real wage. However, since real profits are expected to be inversely related to the real wage, and total employment may also decline as the real wage rises, if real profits fall by more than the increase in total real labor compensation or if total employment drops by more than the rise in the real wage, the volume of value added may decrease. As a consequence, both the positive and negative impacts on value added volumes of the real wage are consistent with the predictions of the theoretical model.

4.2.4. Specification Tests

The model seems to be well specified, as indicated by the results of the Ramsey RESET test and AR (1) test. The RESET test with the null hypothesis of appropriate model specification passes at the 5% level of significance for all but two of the 13 sectors and multi-sector aggregates. At the 1% level, the test only fails for *Agriculture, hunting forestry and fishing*, suggesting that the specification of the model may not be adequate and, hence, the estimation results must be viewed with caution. The test also fails at the 1% level only for *Agriculture, hunting forestry and fishing* in the extended model with export orientation and import penetration. In the baseline model, the null hypothesis of no autocorrelation of the AR (1) test cannot be rejected at the 5% and 1% level for all sectors and multi-sector aggregates, but *Wholesale and retail trade; Restaurants and hotels*, and *Total services*. The AR (1) test also fails at the 1% significance level for *Total services* in the extended model with export orientation and import penetration.

4.2.5. Test for Endogeneity

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instead of its natural log, is included in the regression, total real GDP tends to drop by 0.6% when the unemployment rises by one percentage point.

An augmented Durbin-Wu-Hausman test is adopted to test for endogeneity of the three explanatory variables, and the test results are reported in Table 2.4. According to the test results, the hypothesis that the real exchange rate is exogenous can only be rejected at the 10% level for *Non-agriculture business sector* and at the 5% level for *Construction*. The null hypothesis of exogenous real GDP is rejected at the 10% level for *Construction*, and *Business sector services*, and at the 5% level for *Total services*. However, if the 1% level of significance is considered, both tests pass for all sectors and multi-sector aggregates. Finally, the real wage is shown to be exogenous at any significance level for all sectors and aggregates. Therefore, given that some of the explanatory variables are shown to be endogenous, only the IV estimator will be consistent. However, it is difficult to find instrumental variables that meet both of the criteria for a valid instrument, i.e., it must be highly correlated with the included endogenous variable but uncorrelated with the error term. Moreover, if the potential instruments are only weakly correlated with the included endogenous variables, the use of the IV estimator may suffer from the “weak instruments” or “weak identification” problem, which is likely to make the situation even worse. According to Pesaran et al. (2001) and Harris and Sollis (2003), the long-run parameter estimates produced by OLS under the ARDL-ECM framework can still be generally consistent and unbiased, and the t-statistics will be valid as well, even when some of the regressors are endogenous.

4.2.6. Robustness Test

To test for robustness of the results, the model is first re-estimated for all nine sectors and *Total economy* by replacing the value added volume with the real value added, i.e., the nominal value added (VALU from the STAN database) divided by the GDP deflator, as the dependent variable. Since this real value added measure is available for more countries and years than is value added volume, to make the results more comparable with one another, the model is re-estimated over the same sample as value added volumes. The estimation results are reported in Table G.2 in Appendix G.

According to the estimation results, a significant and positive relationship between the real exchange rate and real value added exists in both the short and the long run for *Agriculture, hunting, forestry and fishing*, in the short run (since a long-run relationship does not exist based on the PSS t-test) for *Manufacturing*, and in the long run for *Wholesale and retail trade; Restaurants and hotels*. By contrast, real value added declines in the sectors *Construction,* and *Community, social and personal services* in both the short and the long run, as the domestic currency depreciates.

One important issue with the new definition of real value added is that, since the real value added in sector i can be viewed as $\left(P_iQ_i/P\right)$ for simplicity, it is impossible to tell whether a variation in real value added is caused by a change in the quantity, Q_i, or a movement in the relative price, P_i/P. To be more specific, as the domestic currency depreciates, on the one hand, the higher cost of imported intermediate inputs will push up the general price level and put downward pressure on the relative price of goods in a particular sector, even though the quantity of output does not change. On the other hand, the real currency depreciation will raise the price-competitiveness of domestic goods and lead to higher foreign demand, which may be met by a domestic production expansion, even though the relative price of the goods in domestic currency terms may not change (or it may increase if the output expansion requires extra labor inputs which push up the total cost of production). Hence, an exchange rate movement can cause real value added to change through variations in either the relative price, P_i/P, or the quantity of goods, Q_i, or both. However, we are not able to tell, from the estimation results, which is the main cause of changes in real value added.

This issue can be addressed by making a comparison between the exchange rate effects on real value added and on value added volume for a particular sector. For example, a one percent real currency depreciation is found to raise the *Manufacturing* real value added and value added volume by, respectively, 0.237 (= (0.241+0.134)*0.633) and 0.222 (= (0.191+0.16)*0.633) percent in the short run. The difference between these two values, 0.015 (=0.237-0.222), should, therefore, be considered as the increase in the relative price (base year = 2000) caused by the real currency depreciation[42].

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[42] For example, suppose that an economy produces only two goods, A and B. In 2008, the nominal GDP is equal to $P_{08}^{A}Q_{08}^{A}+P_{08}^{B}Q_{08}^{B}$, the real GDP measured in the price of 2000 is $P_{00}^{A}Q_{08}^{A}+P_{00}^{B}Q_{08}^{B}$, and the GDP deflator is equal to $\left(P_{08}^{A}Q_{08}^{A}+P_{08}^{B}Q_{08}^{B}\right)/\left(P_{00}^{A}Q_{08}^{A}+P_{00}^{B}Q_{08}^{B}\right)$. Therefore, the value added volume (i.e., the value added in constant prices) of sector A in 2008 is equal to $P_{00}^{A}Q_{08}^{A}$, while its real value added is calculated as $\left(P_{08}^{A}/GDP\text{ deflator}\right)Q_{08}^{A}$. As a result, from the

Similarly, as the domestic currency depreciates by one percent, the real value added of the *Construction* sector will drop in the short run by 0.256 (= (-0.211-0.193)*0.633) percent, with the quantity falling by 0.193 (= (-0.124-0.181)*0.633) percent and the relative price by 0.063 percent. In the long run, the drop in the relative price as a result of the domestic currency depreciation tends to have a smaller contribution to the decline in real value added, with about 18% of the change in real value added accounted for by the price change[43]. In the sector *Community, social and personal services*, however, the exchange rate-induced fall in the volume of value added (-0.435 percent = -0.687*0.633) tends to be greater than that in real value added (-0.37=-0.584*0.633) in the long run. As a consequence, the relative price will, in fact, increase by 0.065 percent. Hence, a real currency depreciation seems to be more likely to raise both the value added volumes and real value added for the tradable-good sectors, and reduce both for the non-tradable-good sectors. The relative prices, however, may either increase or decrease as the domestic currency depreciates.[44] At the aggregate level (*Total economy*), a real currency depreciation is found to raise both the value added volume and real value added. In particular, as the domestic currency depreciates by one percent, the total volume of value added increases by 0.034 (=0.053*0.633) percent in the short run, while total real value added rises by 0.037 (=0.059*0.633) percent, indicating an increase of only 0.003 percent in the relative price[45].

To make the estimation results comparable with the findings in Chapter 1, the model is also re-estimated for the nine sectors that comprise the total economy by

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year 2000 to 2008, the only thing that changes in the value added volume is Q^A, while both Q^A and the relative price $\left(P_{08}^A / GDP \text{ deflator}\right)$ change in the real value added measure. The difference between the growth rates of these two measures should thus be considered as a change in the relative price.

[43] The long-run real value added of *Construction* declines by 0.754 (= -1.191*0.633) percent as the domestic currency depreciates by one percent, while the fall in the volume of value added caused by the same depreciation is 0.619 (=-0.978*0.633) percent. Hence, the change in the relative price is -0.14 percent, which accounts for 17.9% of the change in real value added.

[44] Table G.1 in Appendix G provides a full list of the correlation coefficients between changes in the real exchange rate and those in value added volumes, real value added, and relative prices, and Table G.5 shows how the relative price of each sector fluctuates in the short and the long run following a real exchange rate movement.

[45] This can be viewed as a measurement error, because the relative price for *Total economy* is equal to 1 ($= P/P$), so that the value added volume and real value added should be equivalent.

including in the regression exchange rate volatility, which is the weighted standard deviation of the 8-quarter difference in the log of the nominal effective exchange rate, and the real long-term interest rate, respectively. The results show that exchange rate volatility only significantly affects value added volumes for three sectors, namely, *Agriculture, hunting, forestry and fishing*, *Electricity, gas and water supply*, and *Non-agriculture business sector*, in the long run. In particular, the volume of value added tends to rise in the former sector and drop in the latter two as exchange rate volatility increases. If real value added is used as the dependent variable, a significant and positive impact of exchange rate volatility only exists in the *Manufacturing* sector in both the short and the long run, consistent with the finding in Chapter 1.

The real long-term interest rate, which is a proxy for the real cost of capital, is expected to have a negative effect on sectoral real value added. However, among the nine sectors, a negative and significant relationship between real value added and the real long-term interest rate is only found for *Construction* in both the short and the long run, and for *Transport, storage and communications* in the short run.

The inclusion of exchange rate volatility or the real long-term interest rate in the regression barely affects the estimated coefficients on the other explanatory variables, compared to the baseline case. Moreover, the specification of the model does not seem to be improved as either of these variables is included in the regression.

4.2.7. The Manufacturing Sector

For the baseline model, the hypothesis of no long-run relationship between the value added volume and the explanatory variables cannot be rejected at either the 5% or 10% level of significance for three subsectors, namely, *Textiles, textile products, leather and footwear*, *Wood and products of wood and cork*, and *Machinery and equipment* (Table 2.5), and cannot be rejected at either level for the same subsectors except *Wood and products of wood and cork* in the extended model (Table 2.6).

Among the ten subsectors that comprise the *Manufacturing* sector, the real exchange rate is found to have positive and significant impacts on the value added volumes for four in the short run. The effect lasts into the long run for only one subsector, namely, *Basic metals and fabricated metal products* (Tables 2.5 and 3.15 (C)). Also, in Table 2.1, I notice that, among the ten manufacturing subsectors, *Machinery and equipment* has both the largest trade share at 15.90%, and the largest export share of production at 53.6%. Not surprisingly, its value added volume shows the greatest response to a real currency depreciation in the short run, with a 0.299 (= (0.187+0.285)*0.633) percent rise in the volume of value added associated with a one percent real currency depreciation. This finding, together with the finding of insignificant exchange rate effects on the real value added of *Food products, beverages and tobacco*, is consistent with Hahn (2007), in which, food production is found to show a zero response while manufacturing of machinery and equipment shows a large one to exchange rate shocks. Moreover, the subsector that has the second largest trade share – *Chemical, rubber, plastics and fuel products*, and the one that shows the third largest export share of production –*Textiles, textile products, leather and footwear*, both show significant value added responses to real exchange rate movements in the short run. These results are thus consistent with our expectation that the subsectors that are more externally oriented should be more responsive to real exchange rate movements.

For the subsector *Basic metals and fabricated metal products* whose volume of value added is significantly affected by the real exchange rate in both the short and the long run, its trade share and export share of production are only in the middle of the respective ranges. Therefore, apart from the degree of openness, other factors, such as the degree of production differentiation, the price elasticity of demand, and the competitive structure of the market, may also have implications for the relationship between the real exchange rate and a sector's volume of value added. Based on the average price-over-cost mark-up for each sector reported in Table 2.1, there seems to be a tendency that the subsectors that have lower price-over-cost mark-ups and, therefore, are more competitive, show relatively higher responses of value added volumes to real exchange rate shocks. In particular, *Textiles, textile products, leather and footwear* (0.12), and *Machinery and equipment* (0.128), which have among the lowest mark-ups, are most responsive to real exchange rate variations among the four subsectors that are significantly affected. The other two subsectors, namely, *Basic metals and fabricated metal products*, and *Chemical, rubber, plastics and fuel products*, which have relatively higher mark-ups, are found to show weaker responses to the real exchange rate. Hence, consistent with Campa and Goldberg (2001), after the trade orientation of an industry is taken into account, low-markup industries tend to show more significant responses to real exchange rates than do high-markup industries.

By incorporating export orientation and import penetration in the model, one is able to evaluate the relative importance of each channel through which the real exchange rate may affect the volumes of value added. According to the estimation results reported in Tables 2.6 and 3.15 (C), six subsectors now show significant responses of value added volumes to real exchange rate movements in either the short or the long run through any of the three channels, i.e., the export, import, and residual (i.e., the trade-weighted real exchange rate) channels. Moreover, even though the exchange rate impacts through the three channels are found to be either positive or negative, the net responses that are significant are only positive, as in the baseline model.

Also, it seems that the value added volumes of the non-durable-goods industries tend to be more responsive to real exchange rate variations than do those of the durable-goods industries when individual transmission channels of the exchange rate are taken into account. Although significant exchange rate impacts through the individual channels are observed for both durable and non-durable-goods industries in either time period, the net effects are significant primarily in non-durable-goods industries. In particular, the value added volumes of all five non-durable-goods industries are significantly responsive to real exchange rate changes in either the short or the long run, while in only one durable-goods industry, namely, *Basic metals and fabricated metal products*, is value added found to be significantly affected by the real exchange rate.

Real GDP is still an important determinant of value added volumes for nine subsectors in the short run, but loses its importance in eight in the long run, leaving *Other non-metallic mineral products*, and *Manufacturing nec.; Recycling* the only subsectors that are significantly affected in both the short and the long run. The diminishing importance of real GDP in the determination of value added volumes for seven subsectors in the long run may be explained by their reduced reliance on the domestic market in the long run through export expansions or shifting production overseas. Similarly, since *Other non-metallic mineral products*, and *Manufacturing nec.; Recycling* have virtually the lowest trade shares among the ten subsectors, they may still show strong reliance on the domestic demand even in the long run. In addition, the real wage of the total economy is still not an important determinant of value added volumes for the manufacturing subsectors as for the sectors that comprise the total economy. In particular, a one percent real wage increase is only found to significantly reduce the short-run value added volume of *Pulp, paper, paper products, printing and publishing* by 0.341 percent.

The Durbin-Wu-Hausman test is used to test for endogeneity of the three explanatory variables. In particular, the null hypothesis of an exogenous real exchange rate is rejected only for *Other non-metallic mineral products* at the 5% level of significance and for *Transport equipment* at the 10% level. The hypothesis of exogenous real GDP is also rejected for *Basic metals and fabricated metal products* at the 5% significance level and for two other subsectors at the 10% level. Nevertheless, if the 1% significance level is considered, both tests, together with the test for exogenous real wage, will pass for all subsectors.

Next, a Ramsey RESET test is adopted to test for general model specification. In general, the model appears to be well specified. The null hypothesis of appropriate model specification cannot be rejected at the 5% level for only three subsectors, while at the 1% level of significance, the test only fails for *Textiles, textile products, leather and footwear*. The specification problem in the baseline model can be slightly improved for two subsectors when the extended model with export orientation and import penetration is considered, even though the RESET test still fails at the same significance levels. The AR (1) test for serial correlation passes for all subsectors at the 5% level in both the baseline and extended models, with the only exception of *Transport equipment*. At the 1% level, however, the test will pass successfully in both models.

4.3. Asymmetric Exchange Rate Effects

A test for asymmetric exchange rate effects on sectoral value added volumes is conducted by including in the regression a dummy variable, D, which takes a value of 0 if it is a real currency depreciation and a value of 1 otherwise, together with this dummy variable interacted with the trade-weighted real exchange rate. Then, a t-test for the significance of each of these dummy variables as well as an F-test for joint significance are conducted.

The test results reported in Table 2.7 show that, the volumes of value added generally show symmetric responses to real currency depreciations and appreciations. Asymmetric exchange rate effects only occur in the sector *Finance, insurance, real estate and business services* in both the short and the long run, and in *Non-agriculture business sector* only in the long run, although both long-run coefficients are only significant at the 10% level. Moreover, for both sectors, a real currency appreciation tends to reduce the value added volumes by slightly more than a real currency depreciation raises them. The value added volume of the subsector *Food products, beverages and tobacco* is also asymmetrically affected by real currency movements. However, in this case, the increase in the value added volume caused by a real currency depreciation is greater than the appreciation-induced fall in value added.

Also, the constant dummies are found to be negative and significant for three sectors and the subsector *Manufacturing nec.; Recycling*, implying that the autonomous value added volumes; i.e., the volume of value added that is independent of the explanatory variables, are relatively lower when the domestic currency appreciates than when it depreciates. However, for the sector *Finance, insurance, real estate and business services*, the opposite applies. The F-test for joint significance indicates the existence of asymmetric exchange rate effects in the *Manufacturing* sector and four of its subsectors, even though no individual dummy variables appear to be significant in two of them. Generally speaking, despite the existence of asymmetric value added responses to real exchange rate variations among the sectors, the magnitude of asymmetry is typically very small.

4.4. Regional Disparity of Exchange Rate Impacts

As in Chapter 1, a test for whether the responses of value added volumes to real exchange rate variations significantly differ among firms from the European Union (EU) and non-EU countries is performed. The purpose of this test is that, since 14 out of the 20 sample countries are EU members, and due to their geographical proximity and the adoption of common trade policies (as a customs union), it is reasonable to believe that firms from EU and non-EU countries may respond differently to real exchange rate movements in terms of their value added volumes. In Chapter 1, we show that firms from EU countries tend to behave in a quite similar way to firms from non-EU countries, especially in the short run. Significantly different behavior between EU and non-EU firms only occur in the long run in two non-tradable-good sectors and one manufacturing subsector that is among the least internationally involved. Thus, we want to verify if the value added volumes of firms from EU countries will also respond to the real exchange rate in the same way as their profits.

To test this hypothesis, a EU dummy (*EU*), which takes a value of 1 if it is a EU country and 0 otherwise, is constructed. This dummy variable is then interacted with the trade-weighted real exchange rate and included in the estimation equation as an additional regressor. Then the hypothesis of zero coefficient on the dummy-interacted real exchange rate is tested using a t-test. The test results are reported in Table 2.8.

Consistent with the test results in Chapter 1, firms from both EU and non-EU countries tend to show similar responses of value added volumes to real exchange rate variations. However, this is more likely to be the case in the long run. Also, among the five sectors and manufacturing subsectors in which significantly different behavior is observed between firms from EU and non-EU countries, three of them are either non-tradable-good sectors (*Construction*, and *Finance, insurance, real estate and business services*) or manufacturing subsector that is among the least internationally involved (*Manufacturing nec.; Recycling*). Nevertheless, the remaining two sectors turn out to be *Agriculture, hunting, forestry and fishing*, and *Mining and quarrying*, which are obviously tradable-good sectors[46]. In addition, among all these five sectors and manufacturing subsectors, firms from EU countries tend to show significantly weaker (in absolute terms) value added responses to the real exchange rate than do firms from non-EU countries. Moreover, in the sectors *Agriculture, hunting, forestry and fishing*, and *Finance,*

[46] The inconsistence of the test results in Chapters 1 and 2 is largely attributable to the definition of real value added. If real value added is defined as the nominal value added divided by the GDP deflator (which is used in the calculation of real profits), instead of value added volumes, the test results will be more consistent with those from Chapter 1, in the sense that the value added responses between firms from the EU and non-EU countries will not differ significantly in those two tradable-good sectors.

insurance, real estate and business services, opposite actions are taken by EU and non-EU firms.[47]

5. Conclusion

Consistent with the findings in previous studies, a real currency depreciation is found to have both expansionary and contractionary effects on value added volumes for those sectors that comprise the total economy and yet have only expansionary impacts for the manufacturing subsectors.

In this study, the volume of value added is adopted as the measure of real value added for each sector. Compared to another real value added measure, which is defined as the nominal value added divided by the GDP deflator, the value added volume has the advantage that a change in this variable is a quantity change rather than a combination of changes in both the quantity and the relative price that cannot be separated. The volume of value added can be affected by the real exchange rate through either the foreign revenue or the cost of imported intermediate inputs. For two of the tradable-good sectors, namely, *Agriculture, hunting, forestry and fishing*, and *Manufacturing*, and four manufacturing subsectors, the positive revenue effect of a real domestic currency depreciation dominates the negative cost effect, resulting in an increase in the volumes of value added in the short run. The positive exchange rate impacts also last into the long run for *Manufacturing* and the subsector *Basic metals and fabricated metal products*. By contrast, for some of the non-tradable-good sectors, including *Electricity, gas and water supply*, *Construction*, and *Community, social and personal services*, value added volumes fall as the domestic currency depreciates, i.e., the cost effect of the exchange rate dominates the revenue effect. Value added volumes of two multi-sector aggregates, namely, *Non-agriculture business sector*, and *Total economy*, also increase as the domestic currency depreciates. This may be attributable to the positive responses of the *Manufacturing* sector which are large enough to dominate the negative responses of the non-tradable-good sectors. By incorporating

[47] For example, in the sector *Agriculture, hunting, forestry and fishing*, a one percent real currency depreciation leads to an output contraction of 0.399 percent for firms from the non-EU countries, but to a rise in the value added volumes for firms from the EU countries by 0.179 (=0.578-0.399) percent. The opposite applies to *Finance, insurance, real estate and business services.*

sectoral export orientation and import penetration in the regression, I find that the real exchange rate can significantly affect value added volumes through the export, import and residual channels. Also, even though the exchange rate effects through the individual channels are found to be either positive or negative, the net impacts are still positive for the two tradable-good sectors and *Total economy*, and are very close to the baseline values. However, a net drop in the value added volume of the *Mining and quarrying* sector associated with a real currency depreciation is observed in the short run. This establishes *Mining and quarrying* as the only tradable-good sector that experiences an output contraction as the domestic currency depreciates, although this conclusion is not supported by the estimation result from the baseline model.

To test for the robustness of the results, the model is re-estimated by replacing the value added volumes with the nominal value added divided by the GDP deflator as the dependent variable. By comparing the estimation results from both models, I observe that, as the domestic currency depreciates, both the value added volumes and real value added are likely to increase for the tradable-good sectors, and decrease for the non-tradable-good sectors. The relative prices, however, may either rise or fall.

Therefore, a real currency depreciation, which is found in Chapter 1 to have both expansionary and contractionary effects on the real profits of the non-tradable-good sectors, in fact, only has contractionary or insignificant impacts on their volumes of value added, especially in the long run. For the economy as a whole, aggregate real profits increase in both the short and the long run as the domestic currency depreciates, while total real GDP only shows a small increase in the short run, following a real currency depreciation. This suggest that, even thought two of the tradable-good sectors gain from a real currency depreciation, their gains can barely compensate for the losses of the non-tradable-good sectors, especially in the long run. Hence, the policy implication from this chapter is that, if the government attempts to devalue its currency so as to expand exports for the tradable-good sectors and boost the economy, the tradable-good sectors are likely to gain, while the economy as a whole can hardly benefit from this policy, especially in the long run, due to losses of the non-tradable-good sectors.

Chapter 3. Effects of the Exchange Rate on Real Wages and Employment

1. Introduction

The international economy in the post-Bretton Woods era is characterized by extremely large fluctuations in real exchange rates. These exchange rate variations have brought about volatility in the profitability of firms in both the tradable- and non-tradable-good sectors through the demand and cost channels and, in turn, considerably affected their investment decisions. As has been discussed in Chapter 1, exchange rate variations can affect a firm's profits by influencing either the foreign-currency price of and the demand for its products in the export market (i.e., the demand channel), or the cost of its imported intermediate inputs in domestic currency terms (i.e., the cost channel). Nevertheless, the profits and investment decisions of a firm may also be influenced by exchange rate variations through their impacts on the cost of labor. For example, a real currency depreciation is likely to have an inflationary effect on the domestic economy through a high cost of imported inputs and products. If the nominal wages lag the price increase, real wages will fall, which will, in turn, discourage labor supply and lower domestic employment. This area, however, is usually ignored by researchers who tend to focus their attention on the former two channels of the exchange rate-profit-investment link.

Now that the relationship between the real exchange rate and real profits and that between the real exchange rate and real value added have been investigated in the previous two chapters, this chapter will take one step further by examining the influence of exchange rate movements on labor costs for the same 20 OECD countries during the period 1971-2008. The total labor compensation of a sector, which is a product of the wage rate, or labor compensation per employee, and total employment of the sector, is an important determinant of sectoral profits. This chapter will investigate how real labor compensation per employee and total employment of each sector respond to real exchange rate variations. This may help explain how changes in these two labor-market variables contribute to movements in real profits and real value added as the exchange rate fluctuates .

In Figures 3.1 and 3.2, I plot how each sector's share in total employment and each subsector's share in total manufacturing employment change over time. Figure 3.1 shows that job opportunities in all three tradable-good sectors, namely, *Agriculture, hunting, forestry and fishing*, *Mining and quarrying*, and *Manufacturing*, have been shrinking over the entire sample period, with *Manufacturing* employment experiencing the sharpest drop from an average share of 25.52% in 1971 to only 14.1% in 2008. By contrast, all the service sectors, except *Transport, storage and communications*, have been expanding constantly over the past 40 years. In particular, the share in total employment of the sector *Finance, insurance, real estate and business services* increased substantially from an average of 6.49% in 1970 to 15.77% in 2008, which is the most dramatic growth among all service sectors. Moreover, for the 20 sample countries, service sectors in total (*Total services*) accounted for around 73.51% in total employment in 2008, compared to 53.27% in 1970 – an increase of more than 20% over the past 40 years.

As for the manufacturing subsectors, their shares in total manufacturing employment stay relatively stable over the entire sample period. The only two exceptions are *Machinery and equipment*, and *Textiles, textile products, leather and footwear*, which had the largest (16.92%) and second largest (15.38%) shares in manufacturing employment in 1970, respectively. However, in 2008, the share of *Machinery and equipment* in total manufacturing employment rose to 22.45%, which was still the largest among all ten subsectors. The share of *Textiles, textile products, leather and footwear*, on the contrary, dropped to only 5.34% in 2008.

An overview of the data is presented in Table 1. It shows for all sectors, multi-sector aggregates and manufacturing subsectors that, changes in total real labor compensation are positively and significantly correlated with changes in both real labor compensation per employee and in total employment. Also, variations in these three variables are usually negatively and significantly correlated with real exchange rate movements, especially in the non-tradable-good sectors and multi-sector aggregates. These correlations, however, are usually insignificant for the tradable-good sectors and manufacturing subsectors, with only a few exceptions. Moreover, the correlation coefficients which are significant are typically smaller for the tradable-good sectors and manufacturing subsectors than for the non-tradable-good sectors and multi-sector aggregates. This may serve as evidence that the real exchange rate may play a more important role in the determination of real wages, employment, and total real labor compensation for the non-tradable-good sectors and multi-sector aggregates than for the tradable-good sectors.

The rest of this chapter is organized as follows: Section 2 gives a review of the previous literature on impacts of exchange rate variations on wages and employment at both the sector and aggregate levels. The theoretical model is constructed in Section 3, and the ARDL-ECM framework proposed by Pesaran et al. (2001) is adopted in the empirical analysis in Section 4. Section 5 concludes this chapter.

To preview the results, for the non-tradable-good sectors and multi-sector aggregates, a real currency depreciation tends to put downward pressure on either real wages alone or on both real wages and employment, especially in the short run. By contrast, the real wages of *Manufacturing* and three of its subsectors decrease as the domestic currency depreciates, while the employment levels of *Manufacturing* and two of its subsectors are found to increase following a real currency depreciation. In other words, both real wages and employment tend to fall for the non-tradable-good sectors, as the value of the domestic currency decreases. These two labor market variables, however, tend to move in opposite directions or are simply unresponsive to real exchange rate variations for the tradable-good sector and manufacturing subsectors.

After taking into account the exchange rate impacts on sectoral real profits and real value added from the previous two chapters, I conclude that the positive profit growth in the tradable-good sectors and manufacturing subsectors associated with real currency depreciations are determined primarily by the depreciation-induced growth in real value added. Whereas the exchange rate effects on real profits in those non-tradable-good sectors rely crucially on the relative strengths between the adjustments in real value added and those in real wages and/or employment, as a result of the exchange rate movement. When real value added falls more than does real labor compensation (i.e., either real wages, or employment, or both decrease), as the domestic currency depreciates, real profits will decline, such as in the *Construction* sector. On the contrary, when real labor compensation drops more relative to real value added, real profits are likely to increase, such as in *Business sector services*, and *Total services*, or become insensitive to real exchange rate changes, such as in *Community, social and personal services*.

2. Review of the Literature

In the simplest theory, when the labor market is efficient, on the one hand, real wages increase (decrease) as labor supply falls (rises), other things being equal. If real wages fail to fall, then unemployment will increase, or alternatively, demand for labor will fall. On the other hand, an increase in labor demand pushes up real wages, which will encourage more people to join the labor force, i.e., labor supply will increase. According to De Loo and Ziesemer (2001), who study the determinants of growth in sectoral average wage and employment for the US and six European countries, sector-specific labor supply has the greatest influence on the growth of both wages and employment in all countries, but the UK. Also, a higher percentage of both wage and employment growth is explained by technical change than by changes in the terms of trade before the 1980s, but the opposite applies from the 1980s and onwards. In addition, apart from the market mechanism which automatically matches real wages with different levels of employment, other factors, including institutional factors, such as government regulations, minimum wage laws, unemployment benefits, and unionization may also have a great influence on labor markets.

Moreover, wages and employment may also be affected by variations in the exchange rate. In the existing literature, a large proportion of studies have focused on the exchange rate's impacts on the manufacturing sector (e.g., Branson and Love, 1986, 1988; Revenga, 1992; Campa and Goldberg, 2001) due to its high degree of external orientation. It is, in fact, not uncommon to find significant impacts of exchange rate movements on wages (both nominal and real) and employment in the literature (for example, Dornbusch and Fischer, 1986; Dornbusch, 1987; Branson and Love, 1986, 1988; Revenga, 1992; Burgess and Knetter, 1998; Goldberg and Tracy, 1999, 2001; Campa and Goldberg, 1999, 2001; Bahmani-Oskooee, Mirzaie and Miteza, 2007). Generally speaking, a currency appreciation (depreciation) tends to be associated with declines (rises) in nominal wages and employment, which adjust to the deflationary (inflationary) effect of the appreciation (depreciation), while real wages may move in either direction (Bahmani-Oskooee, Mirzaie and Miteza, 2007).

Some studies focus exclusively on the influence of exchange rate variations on either wages or employment. For example, Branson and Love (1986, 1988) examine the effect of exchange rate movements on US manufacturing employment and output using data for the 1970s and early 1980s. They find that real exchange rate variations have significant implications for employment in the US manufacturing sector, with dollar appreciations (depreciations) associated with significant output and employment drops (rises), especially in durable-goods sectors. Burgess and Knetter (1998), who evaluate the responses of employment to exchange rate variations for 14 industries that have some linkage to international markets in G-7 countries during 1970-1988, also find declining manufacturing employment associated with real currency appreciations. Also, the size of the exchange rate effects is related to industry characteristics such as the competitive structure. In Goldberg and Tracy (1999), dollar appreciations (depreciations) are found to cause small but significant decreases (increases) in workers' hourly earnings in US local labor markets. However, the magnitudes and even the signs of these exchange impacts vary substantially across different industries or industries in certain regions. In addition, the adverse effects of real currency appreciations on employment increase with the export orientation of an industry and decrease with its reliance on imported inputs.

There are also studies that take into account the exchange rate impacts on both labor market variables. Revenga (1992) finds that the dollar appreciation in the first half of 1980s significantly reduced US manufacturing real wages by 2 percent, which is smaller than the impact on employment (4.5 -7.5 percent). This suggests that most of the adjustments in the labor market caused by an adverse trade shock occur through employment instead of wages. However, Campa and Goldberg (2001) demonstrate that wages in the US manufacturing industries are considerably more responsive to real exchange rate variations than employment. They also find that the real wage elasticities of response increase with the export orientation of the industries and decrease (and even turn negative) with their reliance on imported inputs. In addition, as external orientation is taken into account, the exchange rate has the most significant impact on the wages and employment of low-markup industries (such as textiles, lumber and wood products, and primary metal or fabricated metal products) and those with a less-skilled labor force. Nevertheless, if the degree of external orientation is controlled for, the exchange rate is expected to have a larger influence on higher-markup industries.

As regards the result in Campa and Goldberg (2001) that industry wages are more responsive than employment to exchange rate fluctuations, Goldberg and Tracy (2001) point out that this result may be attributable to the use of industry aggregate data that ignore the exchange rate's impact on individual workers. The observed responses of employment to the exchange rate only capture net employment changes, and only among the workers that move across industries. Any changes in gross employment (i.e., job churning or turnover) or in those workers that still stay within broadly-defined industries are totally missed in aggregate data. Using population survey data for the period 1976-1998, Goldberg and Tracy find that exchange rate movements have a strong impact on the wages of workers that are undergoing job transitions, but a small impact on those that remain with the same employer. In addition, the least educated workers are found to be most seriously affected by exchange rate variations.

Kandil and Mirzaie (2003) use a theoretical rational expectation model that decomposes movements in the real exchange rate into anticipated and unanticipated components to examine the impacts of real exchange rate fluctuations on US sectoral employment and nominal wages. They find that an unexpected real dollar appreciation has a deflationary effect on industrial nominal wages in manufacturing and transportation industries. Also, employment growth responds negatively to an unanticipated real appreciation of the dollar in the construction industry and at the aggregate level, but positively in the mining sector which has the largest import share among all US industries.

Bahmani-Oskooee, Mirzaie and Miteza (2007) adopt the cointegration and error-correction modeling techniques to investigate both the short- and long-run effects on employment, and nominal and real wages of the real exchange rate. Using data for eight sectors of the US economy (i.e., *Construction*, *Finance*, *Manufacturing*, *Mining*, *Retail Trade*, *Service*, *Transportation*, and *Wholesale Trade*) during 1961-2000, they find that a real dollar depreciation only has a short-run positive effect on employment and wages for most sectors. In the long run, the effect tends to be neutral. Mo (2009) studies the responses of real wages and employment to exchange rate fluctuations for 18 US manufacturing industries using an error-correction model. In contrast to the finding of only a short-run exchange rate effect on wages and employment in Bahmani-Oskooee et al. (2007), she shows that real exchange rate movements have significant impacts on employment and real wages in both the short and the long run, especially in those industries that rely more heavily on imported inputs. In addition, an industry's ability to price-to-market tends to be weakly related to its wage and employment in the sense that significant exchange rate effects are found for both the low- and high-markup industries.

Contrary to the finding of significant relationships between wages and the exchange rate in those studies listed above, Gagnon (2006) only finds a very small influence of exchange rate changes on total labor costs for each sector in the United Kingdom. Himarios (1993) argues that the effects of the exchange rate on wages are unstable, and supports his view by showing that the sharp dollar depreciation after 1985 only led to an insignificant and lower-than predicted increase in US wages.

Apart from the movements in wages and employment caused by exchange rate variations, the misalignment of exchange rates can also lead to fluctuations in wages. Dornbusch (1987a) argues that industry wages respond directly to the competitive pressure of exchange rate appreciations or depreciations and indirectly to changes in the cost of living. This is the so-called “competitiveness hypothesis,” which uses exchange rate variations to capture the impacts on wages over and beyond those caused by changes in the cost of living (Himarios, 1993). According to this view, a persistent overvaluation that induces foreign competition and entry will put downward pressure on wages of the domestic firms so as to maintain them in the market.

This current study will contribute to the literature by investigating the impacts on real wages and employment of the real exchange rate at both the aggregate and sector levels for 20 OECD countries. Using the ARDL-ECM approach proposed by Pesaran et al. (2001), I am able to estimate both the short- and long-run effects simultaneously and examine how the exchange rate impacts develop over time. Also, unlike previous studies, most of which focus on either only one country (typically the US) or only on one or a few industries (usually manufacturing), the sample of this current study contains nine sectors that comprise the total economy, including both tradable- and non-tradable-good sectors, four multi-sector aggregates, including *Total economy*, and ten manufacturing subsectors for 20 OECD countries during the period 1971-2008. Therefore, the findings of this study will provide more general evidence that is applicable to the analysis of a wider range of countries and industries.

3. The Theoretical Model

Assume that a representative firm in sector i of the home country produces output using two inputs, namely labor, L_i, and an imported intermediate input, M_i (such as oil), and sells products to both the domestic and foreign markets. Assume as well that the firm has some market power, and hence price-setting ability, in both markets.

The representative firm maximizes its profits:

$$\frac{\Pi_i}{P} = \max_{P_i, P_i^f, L_i, M_i} \left\{ \begin{array}{l} \frac{P_i}{P} Q_i\left(\frac{P_i}{P}, Y\right) + \left(\frac{EP^f}{P}\right)\left(\frac{P_i^f}{P^f}\right) Q_i^f\left(\frac{P_i^f}{P^f}, Y^f\right) \\ -\frac{W_i}{P} L_i - \left(\frac{EP^f}{P}\right)\left(\frac{P_M^f}{P^f}\right) M_i \end{array} \right\}, \qquad (3.1)$$

subject to the production function:

$$Q_i + Q_i^f = f\left(L_i, M_i\right) , \tag{3.2}$$

where the demand functions are specified as follows:

$$Q_i = Q_i\left(\frac{P_i}{P}, Y\right), \frac{\partial Q_i}{\partial\left(P_i/P\right)} < 0, \frac{\partial Q_i}{\partial Y} > 0, \tag{3.3a}$$

$$Q_i^f = Q_i^f\left(\frac{P_i^f}{P^f}, Y^f\right), \frac{\partial Q_i^f}{\partial\left(P_i^f/P^f\right)} < 0, \frac{\partial Q_i^f}{Y^f} > 0, \tag{3.3b}$$

and $\Pi_i/P =$ the real profits of sector i in the home country.

$P_i, P_i^f =$ the prices of the domestic representative firm's output sold in the domestic and foreign markets, respectively. P_i^f is expressed in the foreign currency.

$P, P^f =$ the general price level in the domestic and foreign countries, respectively. P^f is expressed in the foreign currency.

$Y, Y^f =$ the real income in the domestic and foreign countries, respectively.

$E =$ the nominal exchange rate, which represents the domestic currency price of one unit of foreign currency, and EP^f/P denotes the real exchange rate.

$W_i/P =$ the real wage in sector i .

$P_M^f =$ the world price of the imported intermediate inputs in foreign currency terms, and is assumed to be determined in the world market.

In equations (3.3a) and (3.3b), the representative firm is facing downward-sloping demand curves in both the home and foreign markets. Thus, the domestic and foreign demands for the firm's products are assumed to fall with increases in the relative prices of its products in the domestic and foreign markets, but rise with domestic and foreign GDP, respectively.

Solving the profit maximization problem specified in equation (3.1) yields:

$$L_i = L_i\left(\frac{W_i}{P}, \frac{EP^f}{P}, \frac{P_M^f}{P^f}, Y, Y^f\right) \tag{3.4}$$

As argued in Campa and Goldberg (2001), lots of the previous studies on labor supply are more microeconomic-oriented and focus on changes in market demographics and household structure, which would be expected to be orthogonal to the emphasis on exchange rate variations in this study. Hence, for simplicity, labor supply is modeled as an increasing function of the real wage only, with factors such as worker characteristics being captured by the country and year fixed effects. The labor supply function is expressed as follows:

$$L_i^S = L_i^S\left(\frac{W_i}{P}\right) \tag{3.5}$$

Equate the labor demand function (3.4) and the labor supply function (3.5) to obtain the equilibrium real wages and the equilibrium labor input for sector i:

$$\frac{W_i}{P} = \Theta_i\left(\frac{EP^f}{P}, \frac{P_M^f}{P^f}, Y, Y^f\right) \tag{3.6a}$$

and

$$L_i = \Psi_i\left(\frac{EP^f}{P}, \frac{P_M^f}{P^f}, Y, Y^f\right) \tag{3.6b}$$

For the purpose of estimation, rewrite equations (3.6a) and (3.6b) in logarithm form:

$$w_i - p = \theta_i\left(e + p^f - p, p_M^f - p^f, y, y^f\right) \tag{3.7a}$$

and $$l_i = \psi_i\left(e + p^f - p, p_M^f - p^f, y, y^f\right) \tag{3.7b}$$

where the lower case letters represent the natural logarithms of the corresponding upper case variables.

Following Campa and Goldberg (2001), three channels through which the equilibrium wage and labor input are exposed to exchange rate variations, namely, industry export orientation (x_i), import penetration (m_i), and the use of imported inputs (q_i), are incorporated in the models:

$$w_i - p = \theta_i\left[\left(1 + x_i + m_i + q_i\right)\left(e + p^f - p\right), p_M^f - p^f, y, y^f\right] \qquad (3.8a)$$

and

$$l_i = \psi_i\left[\left(1 + x_i + m_i + q_i\right)\left(e + p^f - p\right), p_M^f - p^f, y, y^f\right] \qquad (3.8b)$$

where $x_i =$ the share of exports in total revenue, which is used to measure the degree of export orientation of sector i ;

$m_i =$ the import penetration rate in sector i of the domestic market;

$q_i =$ the share of imported inputs in total factor inputs in sector i .

Both the equilibrium real wage, $\left(w_i - p\right)$, and equilibrium employment, l_i , in industry i are functions of the real exchange rate, $\left(e + p^f - p\right)$. The wage and employment elasticities with respect to the real exchange rate are influenced by the industry's external orientation, x_i , import penetration, m_i , and the use of imported intermediate inputs, q_i . The wage and employment also vary with the price of the imported intermediate input, $\left(p_M^f - p^f\right)$, real domestic GDP, y , and real foreign GDP, y^f .

A real depreciation of the domestic currency will, on the one hand, make the domestically-produced goods more price-competitive in both the domestic and foreign markets. The higher demand will drive up the domestic production and demand for labor, which will then be matched by a higher labor supply through an increase in the real wage. (i.e., the demand effect). On the other hand, the real currency depreciation will also push up the total cost of production through a higher cost of imported intermediate inputs. To maintain profitability, the domestic representative firm may choose to cut the cost of labor by firing workers (or cutting their work time), or lowering the real wages, or both (i.e., the cost effect). The net responses of sectoral real wages and employment to a real currency depreciation thus depend on the relative strengths of the demand and cost effects of the depreciation. Moreover, as pointed out by Burgess and Knetter (1998, pp.152), if quantitative restrictions are imposed to protect workers in a particular industry, or if labor market regulations considerably push up the costs of hiring and firing workers, then employment may become less sensitive to real exchange rate fluctuations. The problem will be further complicated when the responses of real wages and employment to the inflationary effect of a real currency depreciation are taken into account.

The three channels through which real wages and employment are affected by real exchange rate movements, namely, the export orientation of an industry (x_i), the import penetration of the domestic market (m_i), and the reliance on imported inputs (q_i), capture the sensitivity of real wages and employment to the exchange rate (Campa and Goldberg, 2001). In particular, the larger is the proportion of output exported, the more likely that the representative firm's profits will increase as the domestic currency depreciates, other things being constant. The higher demand for the domestic representative firm's products in the foreign market will lead to higher production and, in turn, higher demand for labor and higher real wages in the domestic country. Labor supply will then increase as real wages rise. Hence, the real exchange rate should have a positive impact on employment and real wages through the export orientation channel. Next, consider the import penetration of the domestic market. For example, when Japanese cars are exported to the US, a real depreciation of the US dollar, or alternatively, a real appreciation of the Japanese yen, will make Japanese cars more expensive relative to US cars in the US market, if the Japanese producers fully or partly pass through the exchange variation into the dollar price of their cars. Under this circumstance, the larger the share of Japanese cars in the US market, or the higher the import penetration ratio, the more likely that the real profits of the US car manufacturers will increase following a real dollar depreciation. In this sense, higher import penetration should also lead to greater responses of the employment and real wages of those domestic firms that directly compete with the foreign exporters to a real currency depreciation. This view is supported by Revenga (1992) that the higher the import share of an industry, the more the domestic labor markets will be hurt (benefit from) by an appreciation (depreciation) of the dollar. Nevertheless, if the Japanese car producers price to market so as to stabilize their export prices in US dollars, or if Japanese and US cars are not close substitutes, there may not be a significant relationship between import penetration and real wages or employment. Finally, the larger the share of imported inputs in total factor inputs, the more likely that the real profits of the domestic representative firm will drop as the domestic currency depreciates. Hence, we should expect a real currency depreciation to inversely affect employment and real wages through the channel of imported inputs. However, the relationship between the reliance on imported inputs and the sensitivity of labor demand to the real exchange rate may also be affected by the structure of production activity and product demand (Campa and Goldberg, 2001).

Other things being equal, an increase in the price of the imported intermediate inputs, p_M^f, will push up the marginal cost of production for the representative firm. If the firm chooses to raise the price of its products in either the home or the foreign market, it is likely to face a decreasing demand for its products and, in turn, lower profits. Employment and real wages are thus both likely to fall as a result of diminishing labor demand.

Domestic output growth tends to boost the demand for all goods in an economy. Thus, as domestic real GDP increases, the higher demand for the representative firm's products will push the firm's demand for labor input. Real wages will also increase to rebalance the demand for and supply of labor. Hence, there should be positive relationships between real GDP growth and employment and between real GDP and real wages. Growth in foreign real GDP tends to lead to higher foreign demand for domestic goods. Thereby, employment and real wages in the domestic country should both increase to facilitate the firm's production expansion.

4. Empirical Application

4.1. Data

To estimate the model in equations (3.10a) and (3.10b), we use annual sector-level data that span the period 1971-2008 for the same 20 OECD countries as in Chapters 1 and 2. The data is again obtained from the OECD databases.

In previous studies, average hourly earnings (e.g., Revenga, 1992; Goldberg and Tracy, 1999; Campa and Goldberg, 2001; Kandil and Mirzaie, 2003; and Bahmani-Oskooee et al., 2007) are typically used as a measure of wages. Employment is usually measured in the existing literature by the number of workers employed (Branson and Love, 1986; Burgess and Knetter, 1998), total hours of all persons (Kandil and Mirzaie, 2003), number of production (or nonfarm) workers in each industry and average person-hours per week (Revenga, 1992; Goldberg and Tracy, 1999; Campa and Goldberg, 2001).In the OECD Economic Indicators database, however, data for hourly earnings is only available for four sectors or multi-sector aggregates, namely, *Manufacturing and Mining*, *Manufacturing*, *Private sector*, and *Industry*, whereas data for weekly hours worked is available only for *Manufacturing*. Thus, no disaggregated-to-sector-level data can be obtained. Fortunately, in the OECD STAN Database for Industrial Analysis, two measures of wages are available, namely, Labor compensation of employees (LABR) and Wages and salaries (WAGE). In particular, labor compensation consists of both explicit monetary remuneration and also non-cash benefits, such as pensions, paid vacations, and healthcare benefits, and, hence, is a more comprehensive measure of payments received by workers in return for the labor they provide. Although it is typically agreed that labor compensation is more difficult to measure than wages, because of the difficulty in measuring non-cash benefits, thanks to the data availability in the OECD STAN database, it is possible to obtain the labor compensation data for this study. Also, data for Total employment (EMPN) is available for all sectors in the same database. Therefore, given the availability of data, to measure the average cost of labor, I divide total labor compensation of each sector by total employment of the same sector to obtain labor compensation per employee, which is then deflated by the GDP deflator to get the value in real terms. Moreover, an average hourly earnings variable can also be constructed by dividing total compensation of employees (LABR) by the total number of hours worked (HRSN), the data of which is also available in the OECD STAN database. Nevertheless, since the HRSN series is unavailable for eight countries in the sample, and the data is also incomplete for the remaining 12 countries, we will still stick to the real labor compensation per employee as the measure of real wages.

Domestic real GDP data are obtained from the National Accounts and Main Economic Indicators categories of the OECD database. The foreign real GDP, y^f , is assumed to be the world output facing all sample countries and, thus, can be captured by the vector of year dummies, θ_{it} . The price of the tradable imported inputs, p_M^f , is assumed to be determined in the world market, and hence should also be facing all countries at a given point of time. Consequently, the vector of year dummies, θ_{it} , also capture the effects of this variable on sectoral real wages and employment.

Data for the real exchange rate is obtained from the series Real effective exchange rate in the OECD Economic Indicators database. The logarithm of the inverse of the real exchange rate is weighted by each country's average trade share (total exports plus total imports) in nominal GDP to take into account the international exposure of each country. Although, in the extended theoretical model, the real exchange rate is interacted with export orientation, import penetration, and imported input use to emphasize the three channels through which employment and real wages are affected by real exchange rate movements, only two channels, namely, the export orientation and import penetration channels, are explicitly considered in the empirical analysis due to data availability. The effects of the use of imported intermediate inputs on sectoral real wages and employment, however, can still be captured by the coefficients on the non-interacted real exchange rate[48]. Moreover, since data for exports and imports are only available in the OECD STAN Database for the tradable-good sectors and manufacturing subsectors, and in the OECD National Accounts Statistics for *Total services* and *Total economy*, the extended model with the two channels are thus only estimated for these sectors. Also, modified measures of export orientation and import penetration are included in the regression: export orientation is calculated as the

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[48] As in Chapters 1 and 2, the non-interacted real exchange rate is still weighted by each country's average trade share in total GDP. Therefore, if the real exchange rates interacted with, respectively, the export orientation and import penetration are both insignificant, the model can be reduced to the baseline model, assuming that the lag lengths on all other variables are the same in both models.

share of exports in each sector's value added, and import penetration is equal to sectoral imports divided by (sectoral value added plus imports less exports).[49] In addition, to avoid the issue of simultaneity in the estimation process, the average export and import shares for each country are adopted in the regression. Note that, Campa and Goldberg (2001, pp.482) also considered only two channels in the estimation of their model, namely, the export to production share in the industry, and the share of imported inputs into production costs, due to the high intra-industry correlations between import penetration and imported input use.

4.2. Estimation Methodology

Exchange rate shocks may have short-run or even long-run effects on the economy. Hence, it is necessary to examine both of these potential effects of the exchange rate on sectoral real wages and employment. The ARDL-based approach used in Chapters 1 and 2 has several advantages of identifying the short- and long-run effects of economic shocks. This is made obvious by transforming the ARDL framework into an error-correction model. By doing so, the ARDL model can be used to estimate both the short- and long-run coefficients of a model simultaneously (Baek and Koo, 2006). For example, OLS can be used to consistently estimate the long-run coefficients once the lag structure is identified (Pesaran et al., 2001). Moreover, the estimated relationships will still be unbiased even if some of the variables are endogenous, and, hence, the t-statistics will still be valid (Harris and Sollis, 2003). Most importantly, this method is applicable regardless of whether the regressors are purely $I(0)$, purely $I(1)$, or mutually cointegrated (Pesaran et al., 2001). This is important because most of the conventionally used unit root tests, such as the Dickey-Fuller (DF) tests and Phillips-

[49] According to the definitions in the OECD STAN Indicators Database, sectoral production is the denominator of both export share of production and import penetration. The same definition of export share in production is adopted in Campa and Goldberg (2001) as well. However, production data is not available in the OECD STAN Database for Australia in all sectors, and is incomplete, relative to value added, for several other countries in some sectors or manufacturing subsectors, especially in *Agriculture, hunting, forestry and fishing*, and *Mining and quarrying*. As a result, if we calculate export orientation and import penetration using production, rather than value added data, the sample size of a sector will shrink considerably, thus making the estimation results generally incomparable with the baseline results. Also, for the subsector *Chemical, rubber, plastics and fuel products*, import penetration is defined as the share of imports in value added, since the ratio will be negative if it is defined otherwise.

Perron (PP) tests, tend to have only limited power in a small sample. The adoption of the panel versions of these tests or some other new testing methods, such as the Levin-Lin (LL), Im-Pesaran-Shin (IPS) and Fisher's tests, cannot help to solve this problem, either. Thus, by adopting the ARDL-based approach proposed by Pesaran et al. (2001), it is not necessary to pre-test for unit roots for the variables included, which will avoid the problems of those tests.

Equations (3.10a) and (3.10b) can be transformed into a general ARDL model with lags (s_1, g_1) and (s_2, g_2) for the wage and employment equations, respectively, and g_1 and g_2 are allowed to differ across the explanatory variables.

$$\left(w_i - p\right)_{ct} = \sum_{j=1}^{s_1} \gamma_{ij}\left(w_i - p\right)_{c,t-j} + \sum_{j=0}^{g_1} \beta_{ij}' X_{ic,t-j} + \eta_{ic} + \theta_{it} + \varepsilon_{ict} \tag{3.11a}$$

$$l_{ict} = \sum_{j=1}^{s_2} \alpha_{ij} l_{ic,t-j} + \sum_{j=0}^{g_2} \phi_{ij}' X_{ic,t-j} + \eta_{ic} + \theta_{it} + \varepsilon_{ict} \tag{3.11b}$$

where $\left(w_i - p\right)_{c,t-1}$ and $l_{ic,t-1}$ are, respectively, the one-period lags of $\left(w_i / p\right)_{ct}$ and l_{ict} , $X_{ic} = \left(\left(e + p^f - p\right)_t, x_{ict}\left(e + p^f - p\right)_t, m_{ict}\left(e + p^f - p\right)_t, y_t\right)'$ for the sectors *Agriculture, hunting, forestry and fishing*, *Mining and quarrying*, *Manufacturing* and the ten manufacturing subsectors, and $X_{ic} = \left(\left(e + p^f - p\right)_t, y_t\right)'$ for all other sectors, $X_{ic,t-j}$ represents the *j*-period lag of X_{ict} , respectively, η_{ic} and θ_{it} are the vectors of country and year dummies, respectively, ε_{ict} is a well-behaved error term with mean zero and variance σ_i^2 .

Rearrange equations (3.10a) and (3.10b) to obtain the error-correction model of the ARDL framework:

$$\begin{aligned}\Delta\left(w_i - p\right)_{ct} = {} & \left(\tau_i - 1\right)\left(w_i - p\right)_{c,t-1} + \rho_i' X_{ic,t-1} + \sum_{j=1}^{s_1 - 1} \xi_{ij} \Delta\left(w_i - p\right)_{c,t-j} + \beta_{i0}' \Delta X_{ict} \\ & + \sum_{l=1}^{g_1 - 1} \psi_{il}' \Delta X_{ic,t-l} + \eta_{ic} + \theta_{it} + \varepsilon_{ict}\end{aligned} \tag{3.12a}$$

and

$$\Delta l_{ict} = (\chi_i - 1) l_{ic,t-1} + \omega_i^{'} X_{ic,t-1} + \sum_{j=1}^{s_2 - 1} \upsilon_{ij} \Delta l_{ic,t-j} + \phi_{i0}^{'} \Delta X_{ict}$$
$$+ \sum_{v=1}^{g_2 - 1} \lambda_{il}^{'} \Delta X_{ic,t-v} + \eta_{ic} + \theta_{it} + \varepsilon_{ict} \qquad (3.12b)$$

where $\Delta(w_i - p)_c$, Δl_{ic} and ΔX_c denote, respectively, the first differences of the dependent and independent variables in the two equations. $(\tau_i - 1) = \left(\sum_{j=1}^{s} \gamma_{ij} - 1 \right)$ and $(\chi_i - 1) = \left(\sum_{j=1}^{s} \alpha_{ij} - 1 \right)$ are the error-correction coefficients which measure the speed of adjustments to the long run. $\rho_i = \sum_{j=0}^{g_1} \beta_{ij}$ and $\omega_i = \sum_{j=0}^{g_2} \varphi_{ij}$ are the respective vectors of coefficients on the regressor vector $X_{ic,t-1}$ for the wage and employment equations. ξ_{ij} and υ_{ij} are the coefficients on the $j-\text{th}$ lag of $\Delta(w_i - p)_{ct}$ and Δl_{ict}, respectively. ψ_i and λ_i are the vectors of new coefficients on the explanatory variables. They also reflect the short-run responses of real wages and employment to changes in the explanatory variables.

In the long run, the relationships between the two dependent variables and the explanatory variables can be specified as follows:

$$w_{ic} - p_c = \frac{\rho' X_{ic}}{1 - \tau_i} \qquad (3.13a)$$

and

$$l_{ic} = \frac{\omega' X_{ic}}{1 - \chi_i} \qquad (3.13b)$$

4.3. Model Estimation

The equations 3.12 (a) and (b) are estimated for the same nine sectors, 10 manufacturing subsectors, and four multi-sector aggregates, using panel data for 20

OECD countries during the period 1971-2008. To keep the consistency of the models used in all three chapters of this study and to facilitate comparison of the estimation results, the model is first estimated using the trade-weighted real exchange rate, as in the previous two chapters, to take into account the difference in countries' external orientation (i.e., the baseline model), and then re-estimated using the real exchange rate interacted with the sectoral export orientation and import penetration for the three tradable-good sectors and ten manufacturing subsectors, *Total services*, and *Total economy*. Further, given the use of annual data in this study, the number of explanatory variables, and the sample size of each sector (especially when export orientation and import penetration data are included), it is reasonable to set a maximum of two lags for each variable, and then use the Schwarz-Bayesian Criteria (SBC) to choose the optimal lag lengths for each sector by eliminating the extraneous lags. The short-run coefficients are directly obtained from OLS, and the long-run coefficients are calculated based on equations 3.12 (a) and (b), with the standard errors derived using the delta method. Finally, the robust clustered-by-country estimator of the variance[50] is chosen to take into account the potential problems of heteroskedasticity and autocorrelation within each country. The estimation results for the baseline models and the extended models with export orientation and import penetration for the sectors and multi-sector aggregates are reported in Tables 3.1-3.4, and the results for the manufacturing subsectors are reported in Tables 3.8-3.11.

Also, the model specified in equations 3.12 (a) and (b) are estimated for the nine sectors that comprise the total economy using the seemingly unrelated regression (SUR) estimator. A comparison of the SUR and OLS estimation results is provided in Table 3.6 and 3.7. By using the SUR estimator, the error terms across equations are expected to be contemporaneously correlated (Baum, 2006, pp.236). The method has the advantage of allowing cross-equation restrictions to be imposed or tested and also gaining efficiency in the estimation process (Baum, 2006, pp.236). The higher the correlations of residuals across equations, the higher the efficiency gain will be. However, if the error terms are not correlated across equations, in other words, the variance-covariance

[50] If the cluster-by-year estimator is adopted, the coefficient estimates will still be the same, but the standard errors are smaller than in the cluster-by-country case.

matrix is diagonal, or if X_{ic} is identical across equations, so that GLS is numerically identical to equation-by-equation OLS, there will be no efficiency gains. Also, if the columns of X_{ic} are highly correlated across equations, only small gains will be achieved (Baum, 2006, pp.237). Hence, to test for whether or not significant efficiency gains will be achieved using the SUR estimator, a Breuch-Pagan test for the diagonality of the variance-covariance matrix (or independence of the error terms across equations) with the null hypothesis of diagonality is conducted (Baum, 2006, pp.238). Moreover, all the specifications and restrictions in the OLS estimation process also apply here, including a maximum of two lags assigned to each variable, the use of SBC to determine the optimal lag lengths, and the adoption of the robust-cluster-by-country estimator of the variance.

4.3.1. Error-correction Coefficients

The error-correction coefficients $(\tau_i - 1)$ and $(\chi_i - 1)$ measure the speed of adjustments to the long run for real wages and employment, respectively. According to the estimation results reported in Tables 3.1-3.4 for the 13 sectors and multi-sector aggregates, the error-correction coefficients for both the wage and employment equations have the correct sign (i.e., negative) for all sectors and multi-sector aggregates, whether the baseline or the extended model is considered. However, we are still not able to decide, simply based on these estimated coefficients and their standard errors, whether or not a long-run relationship between the dependent and explanatory variables exists for each sector. This can be accomplished by conducting the PSS t-test with the null hypothesis of zero error-correction coefficients (i.e., no cointegration between the dependent and explanatory variables) in each sector. The t-statistics obtained from the regression are then compared with the 5% and 10% critical value bounds provided in Pesaran et al. (2001) to judge whether a long-run relationship exists. The PSS t-test is carried out using $k = 2$ for both the wage and employment equations in the baseline model, and $k = 4$ for the two equations in the extended model with export orientation and import penetration.

The null hypothesis of no long-run relationship can be rejected at the 5% level of significance for all but three sectors, namely, *Agriculture, hunting, forestry and fishing*, *Manufacturing*, and *Finance, insurance, real estate and business services*, among the 13 sectors and multi-sector aggregates. For employment, the test does not reject a long-run relationship for all sectors but four, including *Agriculture, hunting, forestry and fishing*, *Manufacturing*, *Transport, storage and communications*, and *Finance, insurance, real estate and business services*. If the test is carried out at the 10% significance level, the hypothesis of no long-run relationship cannot be rejected only for *Manufacturing* in the wage equation, and still for the same four sectors in the employment equation. When the extended model with export orientation and import penetration is considered, at the 5% level, a long-run relationship does not exist for *Agriculture, hunting, forestry and fishing*, and *Manufacturing* in both the wage and employment equations. At the 10% level of significance, the hypothesis of no cointegration cannot be rejected only for *Manufacturing* in both equations.

Even though real wages or employment is cointegrated with the explanatory variables in most sectors, their speed of adjustment is fairly low relative to the speed of adjustment of either real profits or real value added. Take the baseline model for example, among those sectors in which a long-run relationship exists, the fastest real wage adjustment is found in the sector *Mining and quarrying*, with only 17.9 percent of the short- and long-run wage gap being eliminated within one year. Employment, on the other hand, adjusts even more slowly to the long run. In particular, *Construction*, which has the highest speed of adjustment, has only 8.8 percent of the employment gap covered after a year.

4.3.2. Real Exchange Rate Parameters

4.3.2.1. Baseline Model

Based on the estimation results reported in Tables 3.1-3.4, and in Tables 3.14 (A)-(B) and 3.15 (B), in which the real exchange rate coefficients that are adjusted for the trade shares are reported, four important features associated with the estimation results can be generalized.

First, negative and significant exchange rate effects on real wages and/or employment tend to prevail in the non-tradable-good sectors and multi-sector aggregates. Particularly, a real currency depreciation significantly depresses real wages for four of six non-tradable-good sectors and three multi-sector aggregates in the short run. The real wages of *Construction*, *Community, social and personal services*, and *Total economy*, will fall in the long run as well, following the real currency depreciation. Employment appears to be less sensitive to real exchange rate variations than are real wages. Among the six non-tradable-good sectors and four multi-sector aggregates, the estimated exchange rate coefficients are all negative, but are only significant for *Construction*, and *Total services* in both the short and the long run, with employment falling with a real currency depreciation. Therefore, the exchange rate-induced labor-market adjustments tend to be more likely to occur through real wages than through employment for the non-tradable-good sectors and multi-sector aggregates. Also, for these sectors and aggregates, the falling real wages and employment following a real currency depreciation may be explained by their heavy reliance on imported inputs together with a lack of export markets so that the cost effect of the currency depreciation dominates its demand effect. Moreover, a real currency depreciation is found to have the greatest adverse impacts on the *Construction* sector. On the one hand, the real wage of *Construction* will drop by, respectively, 0.084 (=-0.133*0.633) and 0.62 (=- 0.979*0.633) percent in the short and the long run, associated with a permanent one percent real currency depreciation. On the other hand, the same currency depreciation will cause its employment to fall by 0.191 (= -(0.149+0.152)*0.633) and 0.404 (= -0.639*0.633) percent in the short and long run, respectively. As a consequence, if the domestic currency depreciates by one percent permanently, the *Construction* sector will respond by cutting its total labor cost (i.e., total labor compensation) by 0.275 (= -0.084-0.191) and 1.024 (= -0.404-0.62) percent in the short and the long run, respectively.

By contrast, the tradable-good sectors, except *Manufacturing*, tend to be insensitive to real exchange rate variations in terms of their real wages and employment. *Manufacturing*, although insignificantly affected in the long run, shows a negative response of the real wage and a positive response of employment to real exchange rate movements in the short run. In particular, a one percent real currency depreciation is found to reduce the real wage of *Manufacturing* by 0.074 (= (-0.149+0.031)*0.633) percent and raise its employment level by 0.073 (= (0.174-0.058)*0.633) percent in the short run, leaving a net fall of only 0.001 percent in total real labor compensation. Up to this point, we can conclude that the real profit growth in the *Manufacturing* sector (see

Table 1.1 (A)), associated with a real currency depreciation is driven primarily by the exchange rate-induced real value added growth, rather than by labor cost reductions.

A possible explanation for falling real wages in both *Manufacturing* and the non-tradable-good sectors associated with a real currency depreciation is as follows: as the domestic currency depreciates, domestically-produced goods will become cheaper relative to foreign goods and, hence, the price of domestic goods can increase to be consistent with the domestic-currency price of imported goods. Since a price index, which measures changes in the general price level of a country, is a weighted average of prices for a certain basket of goods and services (both domestic and imported), the increase in the price of domestic goods and the domestic-currency price of imported goods together will push up the general price level. If nominal wages adjust to the inflationary effect of the real currency depreciation, the response of real wages to the depreciation will depend on its influences on nominal wages and the price. Hence, if the general price level rises faster than do nominal wages in particular sectors, or if nominal wages lag the price increase, real wages will fall accordingly.[51] The lower real wages will discourage labor supply and, as a consequence, employment is likely to fall.

The adverse impact on *Manufacturing* real wage of a real currency depreciation may also be explained by the cross-sector spillovers of exchange rate effects. According to Goldberg and Tracy (1999), the wages of an industry can be affected by exchange rate

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[51] By re-estimating the wage equation with nominal wages in place of real wages, I find that there is still a negative relationship between nominal wages and a real currency depreciation in both tradable- and non-tradable-good sectors in the short run. In particular, the exchange rate coefficients are statistically significant for *Manufacturing*, all six non-tradable-good sectors, and all the multi-sector aggregates except *Non-agriculture business sector*. Moreover, among these sectors, the differences between the estimated exchange rate coefficients on nominal and real wages turn out to be positive in only four, namely, *Wholesale and retail trade; Restaurants and hotels*, *Community, social and personal services*, *Total services*, and *Total economy*, and the differences range from 0.009 to 0.049. Given that the real wage is defined as the nominal wage divided by the GDP deflator, the varying sizes of the coefficient differences may capture changes in the relative price of each sector, instead of just the general price inflation, which may be measured by the coefficient difference of 0.023 for *Total economy*. In the long run, the exchange rate effect on nominal wages turns positive in all sectors, but is only significant at the 10% level for *Manufacturing*. Now that the nominal wages of both tradable- and non-tradable-good sectors are found to also show negative responses to real currency depreciations, the outstripping of the general price level over nominal wages may not be adequate to serve as the explanation of negative responses of real wages, provided that the relative prices, in fact, fall in four sectors as the domestic currency depreciates. In this regard, the spillover effect that will be discussed next may be considered a better explanation for this phenomenon.

variations directly through the industry's own trade orientation, and indirectly through spillovers across industries via expected alternative wages. Given the size of the non-tradable-good sectors (*Total services* plus *Construction* accounts for 75.16% in Table 2.1) relative to that of *Manufacturing* (16.5%) in total economy, a change in the real wages of the non-tradable-good sectors is very likely to put downward pressure on the *Manufacturing* real wage[52]. For example, as the domestic currency depreciates, both the real wages and employment of the non-tradable-good sectors will decline. If labor is allowed to move freely across sectors within a country, then the unemployed workers will try to find new jobs in the tradable-good sectors, especially *Manufacturing*, which tend to expand with the real currency depreciation. The higher labor supply to the tradable-good sectors will not only meet the increasing demand for labor in these sectors, thus leading to a higher level of employment, but also put downward pressure on the real wages (and also nominal wages) of these sectors.

Second, the finding of generally negative impacts on real wages and employment of the real exchange rate, especially for the non-tradable-good sectors, appears to somewhat contradict the results in the previous studies. According to the previous literature, nominal wages and employment, in general, tend to be positively affected by a currency depreciation (e.g., Branson and Love (1986, 1988), Revenga (1992), Goldberg and Tracy (1999), and Mo (2009)), while real wages may respond either positively or negatively to real exchange rate changes (Bahmani-Oskooee et al. (2007)). In this regard, the negative link between a real currency depreciation and employment discovered in this study seems to be against the previous conclusions. The problem is, a large proportion of the existing literature that investigates the exchange

[52] When the wage equation is estimated for *Manufacturing* by including the real wage of the non-tradable-good sectors (i.e., *Total services* plus *Construction*) and the lagged non-tradable-good sector real wage interacted with the (un-weighted) real exchange rate as additional explanatory variables, the real wage of the non-tradable-good sectors is found to have a positive and significant impact on the *Manufacturing* real wage in both the short and the long run (the estimated coefficients are 0.656 and 0.733 in the short and the long run, respectively). Therefore, a decline in the real wage of the non-tradable-good sectors will depress the *Manufacturing* real wage in both the short and the long run. In addition, the estimated exchange rate coefficients will be positive in both the short and the long run, but is only significant at the 10% level in the long run. The estimated coefficient on the wage-interacted real exchange rate is positive and significant (at the 10% level) in the long run, implying that a rise in the non-tradable-good sector real wage tends to increase the sensitivity of *Manufacturing* real wage to real exchange rate variations.

rate effects on wages and/or employment focuses on the US manufacturing sector only, including Branson and Love (1986, 1988), Revenga (1992), and Mo (2009), or only observes a significant relationship between the exchange rate and manufacturing employment (e.g., Burgess and Knetter, 1998). As for the *Manufacturing* sector and its subsectors, I also find positive or insignificant responses of employment to real exchange rate changes, with the only exception of *Other non-metallic mineral products*. The negative and significant exchange rate impacts on employment, however, only exist for some of the non-tradable-good sectors and multi-sector aggregates, namely, *Construction*, and *Total services*. Thus, given that the cost effect of a real currency depreciation is more likely to dominate its demand effect for the non-tradable-good sectors, it is reasonable to expect drops in both real wages and employment in these sectors as the domestic currency depreciates. Moreover, due to the great contribution of the non-tradable-good sectors, especially the service sectors, in total GDP, a real currency depreciation tends to put downward pressure on the real wage of *Total economy* through its adverse effects on the real wages and employment of the non-tradable-good sectors.

Third, the real exchange rate tends to have more pervasive short-run impacts on both real wages and employment. In particular, in the short run, the real wages of five out of the nine sectors and three of the four multi-sector aggregates are significantly responsive to real exchange rate movements, while the number of sectors and multi-sector aggregates whose short-run employment is significantly affected is four. In the long run, however, only three and two sectors and aggregates still exhibit significant responses of real wages and employment to real exchange rate movements, respectively. Moreover, *Construction* tends to be the only sector that shows significant responses of both real wage and employment to real exchange rate variations in both the short and the long run, with the long-run impacts greater than the short-run counterparts in both cases. The generally insignificant exchange rate impacts on both real wages and employment in the long run may be explained by the fact that the real exchange rate always reverses itself over time due to market forces or government intervention (Bahmani-Oskooee et al., 2007). As a consequence, the significant short-run exchange rate effects tend to be offset gradually as time passes.

Finally, there is a tendency for real wages and/or employment of those sectors with lower price-over-cost mark-ups (i.e., the sectors that are more competitive), to be more responsive to real exchange rate fluctuations. According to the average sectoral mark-ups[53] reported in Table 2.1, the three sectors with the lowest price-over-cost mark-ups are *Construction* (0.176), *Community, social and personal services* (0.161), and *Manufacturing* (0.137). Apparently, it is also these three sectors that show the strongest responses of real wages and/or employment to real exchange rate variations. Even though *Manufacturing* is the most competitive among these three sectors, it is also the most internationally involved. Consequently, the strong impact of the real exchange rate on its real wages and employment arising from a low markup tends to be mitigated by its strong ability to expand exports as a result of a high degree of trade orientation.

4.3.2.2. Extended Model with Export Orientation and Import Penetration

The extended model includes not only the trade-weighted real exchange rate itself, but also the (un-weighted) real exchange rate interacted with, respectively, the export orientation and import penetration of a sector. The real exchange rate can now work through three channels, namely, the export penetration channel, the import channel, and the "residual" channel that is left over from the former two channels. There are two advantages of this model: first, it allows one to evaluate the relative importance of each channel in the transmission process of the real exchange rate movements. Second, if the estimated coefficients on the export orientation- and import penetration-weighted real exchange rates are statistically insignificant, the extended model can be reduced to the baseline model, as long as the optimal lag lengths for the trade-weighted real exchange rate and for real GDP are identical in both the baseline and extended models. Tables 3.3, 3.4 and 3.14 (B) report the estimation results of the extended model with export orientation and import penetration.

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[53] The price-over-cost mark-up measures the degree of competition of a sector, with a higher markup indicating a lower level of competition. It is calculated according to the following formula:

$$\text{Price-over-cost markup} = \frac{\text{Production}}{\text{Total costs}} - 1 = \frac{\text{Profits}}{\text{Production} - \text{Profits}}$$

where $\text{Profits} = \text{Value added} - \text{Labor compensation}$. In Campa and Goldberg (1999), a similar measure as $(\text{Value added} + \text{Cost of materials})/(\text{Payroll} + \text{Cost of materials})$ can be found.

It is obvious from the results reported in Tables 3.3 and 3.4 that, the real wage of the *Manufacturing* sector is significantly affected by the real exchange rate through all three channels in the short run, while its employment is significantly affected through the export and residual channels only. Moreover, a real currency depreciation tends to raise both the real wage and employment for *Manufacturing* through the export channel, and reduce them through the residual channel. The effects through the import channel are either negligible or insignificant. In particular, a one percent real currency depreciation is found to, on the one hand, reduce the real wage by 0.191 (=(0.378-0.679)*0.633) percent through the residual channel, and raise it by 0.122 (=(-0.197+0.299)*1.193[54]) percent through the export channel. Employment, on the hand, is lowered by roughly 0.01 (= (-0.44+0.431)*0.633) percent through the residual channel, and increased by 0.078 (= (0.203-0.138)*1.193) percent through the export channel. Thus, the exchange rate effect is relatively stronger on the real wage through the residual channel, and on employment through the export channel. These findings are consistent with the predictions of the theoretical model. In particular, the larger the export orientation ratio, the more likely that the real profits of the export firm will increase following a domestic currency depreciation, and the more likely that employment and real wages will increase for production to expand. Also, since the residual channel measures the exchange rate impacts that are left over from the export and import channels, including the use of imported intermediate inputs, it is likely that the cost effect dominates in the leftover effects and gives rise to a negative response of real wages and employment to a real currency depreciation through the residual channel. By comparing the adjusted exchange rate coefficients of *Manufacturing* reported in Table 3.14 (A) for the baseline model with those in 3.15 (B) for the extended model with export orientation and import penetration, I find that the real exchange rate impacts tend to be quite similar in both cases. Particularly, a one percent real currency depreciation reduces the short-run real wage by 0.075 percent in the baseline model, and by 0.07 percent in the extended model, while the same currency depreciation is found to raise the short-run level of employment by, respectively, 0.073 and 0.07 percent in the two models. This suggests that the exchange rate effects through the

[54] 1.193 is the average export share in value added for the *Manufacturing* sector. See Table 3.15 (A) for a complete list of export orientation and import penetration for each sector.

three channels tend to offset each other in the aggregation process to obtain the net effects.

For both *Agriculture, hunting, forestry and fishing* and *Mining and quarrying*, employment is significantly responsive to real exchange rate changes only through the export channel in the long run and short run, respectively. The net effects, however, are rising employment for *Agriculture, hunting, forestry and fishing* in the long run and insignificant impacts on *Mining and quarrying*. The real wages of these two sectors, as in the baseline model, are both insensitive to real exchange rate variations in either time period. For the service sectors as a whole (*Total services*), the real wage is significantly affected by the real exchange rate through all three channels in the short run, and through the export and import channels in the long run. Even though the wage responses through the export channel are positive, they are apparently outweighed by the negative responses through the other channel(s), resulting in a negative wage-exchange rate relationship in both the short and the long run, although only significant in the short run. The employment level of *Total services* is not significantly responsive to real exchange rate variations through any individual channel. The joint effects, however, still turn out to be significant and negative in both the short and the long run. For *Total economy*, significant exchange rate effects only occur in the short run, with the real wage affected only through the residual channel and employment through the import channel. The net effect is significant only for the real wage, which will drop by 0.102 (= (0.524-0.099)*0.633+0.003*6.291-1.053*0.371) percent in the short run as the domestic currency depreciates by one percent. Moreover, consistent with the findings of the previous two chapters, the joint effects and the baseline effects are virtually identical in both cases, suggesting that the exchange rate impacts through the export and import channels are only negligible or have cancelled each other out.

4.3.3. Real GDP Parameters

Real GDP is expected to have a positive impact on employment, since as real GDP grows, demand for all goods in the economy will increase, which will encourage production expansion and, in turn, higher demand for labor. Real wages tend to increase as the demand for labor rises, since workers will require a higher real wage so as to increase labor supply.

The estimation results in Tables 3.1 and 3.2 show that, real GDP has a significant and positive effect on real wages for all sectors but two in the short run. In the long run, only the wages of *Mining and quarrying*, and *Transport storage and communications* are still significantly responsive to real GDP growth. Nevertheless, both of these real wages decline in response to an increase in real GDP, implying that the general price level may increase faster than the nominal wages in these two sectors, thus resulting in falling real wages. Employment, in contrast, tends to be more sensitive to real GDP growth, with higher employment levels associated with higher output growth in both the short and the long run in five non-tradable-good sectors, two service sector aggregates, and *Total economy*. The tradable-good sectors, on the contrary, are either unresponsive to real GDP growth, or are only significantly affected in either the short or the long run. This suggests that the non-tradable-good sectors rely more heavily on the domestic market and, hence, are more sensitive than the tradable-good sectors to changes in the domestic economic activity.

The magnitude of the impacts of real GDP growth on real wages and employment does not change significantly as the extended model with export orientation and import penetration is considered.

4.3.4. Specification Tests

The general model specification, such as omitted variables and incorrect functional form, is tested using the Ramsey RESET test with a null hypothesis of appropriate model specification. Thus, rejection of the null may serve as an indication of problems with the model and certain modifications or improvements to the model will be needed.

In the real wage case of the baseline model, the RESET test successfully passes for 12 sectors and multi-sector aggregates at the 5% level, and the null hypothesis is rejected at the 1% level for only one sector – *Mining and quarrying*. In the employment case, the null hypothesis cannot be rejected at the 5% level for all but *Electricity, gas and water supply*. Switching to the extended model with export orientation and import penetration, however, does not significantly change the baseline results in either case. In particular, the RESET test still fails at the 1% level for *Mining and quarrying* in the wage equation, and at the 5% level for *Agriculture, hunting, forestry and fishing* in the employment equation.

The use of the robust-cluster-by-country estimator of the variance requires the error terms from different clusters to be uncorrelated, so as to account for the neighbourhood effects which may prevent the disturbances from being independently distributed in cross-sectional data (Baum, 2006, pp.154), but allows the error terms to be correlated over time within each cluster (i.e., country) (Baum, 2006, pp.138). Hence, the potential existence of autocorrelation is still a concern of this study, and the AR (1) test must be carried out for this purpose.

The AR (1) test is performed by regressing the estimated residual obtained from the preliminary regression on its first-period lag (Baum, 2006). In the baseline model, the null hypothesis of no autocorrelation cannot be rejected in either the wage or the employment equation at the 5% level of significance for all but the sector *Electricity, gas and water supply*. For this sector, serial correlation in the error distribution cannot be rejected at the 5% level in the wage equation, and at the 1% level in the employment equation. Generally speaking, for the 12 sectors and multi-sector aggregates, except *Electricity, gas and water supply*, autocorrelation should not be a big problem in the estimation of the model.

4.3.5. Test for Endogeneity

The augmented Durbin-Wu-Hausman test is adopted to test for the exogeneity of the real exchange rate and real GDP. The test results are reported in Table 3.5. For real wages, the null hypotheses that the real exchange rate and real GDP are exogenous cannot be rejected at the 5% level of significance for all 13 sectors and multi-sector aggregates. For employment, the hypothesis that the real exchange rate is exogenous cannot be rejected for all but *Manufacturing* at the 5% level, while the hypothesis of exogenous real GDP is only rejected at the 5% level for *Finance, insurance, real estate and business services*. Nevertheless, at the 1% level of significance, neither hypothesis can be rejected for any sector. Given the existence of endogenous explanatory variables in the regression, the IV estimator will be preferred over OLS in that it will be able to produce consistent parameter estimates. Nevertheless, it is not only difficult to meet both of the criteria for a valid instrument, and the use of an instrument that is only weakly correlated with the included endogenous variable in the IV regression is also likely to suffer from the "weak instruments" problem. Fortunately, under the ARDL-ECM framework, the estimated coefficients produced by OLS can be both consistent and unbiased, as long as the lag structure of the model is identified (Pesaran et al., 2001), even when some of the explanatory variables are endogenous (Harris et al., 2003).

4.3.6. Test for Robustness

To test for whether it will be more efficient to estimate the wage and employment equations using the SUR estimator than using OLS, a Breuch-Pagan test for the diagonality of the variance-covariance matrix with the null hypothesis of diagonality (i.e., independent error terms across equations) is conducted (Tables 3.8 and 3.9). The test results show that the null hypothesis of independent error terms across equations is rejected at the 1% level for all nine sectors, strongly suggesting that using the SUR estimator will achieve efficiency gains.

The major difference between the estimation results obtained using SUR and OLS is that, a long-run relationship between the dependent and explanatory variables tends to exist for virtually all sectors in both the wage and employment equations when the SUR estimator is adopted. The existence of such a long run relationship is only uncertain for *Electricity, gas and water supply* in the employment equation. In addition, the optimal lag lengths tend to be different when SUR and OLS are used to estimate the models.

The estimated exchange rate coefficients are found to significantly differ between the SUR and OLS estimation results for four sectors. For example, there is no long-run relationship between the real exchange rate and employment for *Manufacturing* when OLS is used, whereas the SUR estimation results show that *Manufacturing* employment significantly increases as the domestic currency depreciates. Similar situations also occur in the sectors *Electricity, gas and water supply*, *Transport, storage and communications*, and *Community, social and personal services*. In other words, the real exchange rate is more likely to have a significant impact on either real wages or employment when the SUR estimator is used. However, for the remaining five sectors, the estimation results produced by SUR and OLS are very similar in terms of their signs, magnitudes, and significance levels, suggesting that the estimation results are quite robust.

There are three important reason why OLS is still adopted as the key estimator of the wage and employment equations in this chapter even though the Breusch-Pagan test results suggest that it is less efficient than the SUR estimator: (1) to keep the consistency of the estimation methods and make the estimation results more comparable across all three chapters, (2) OLS can be used to consistently estimate the long-run coefficients as long as the lag structure of the model is identified (Pesaran et al., 2001), whereas there is no evidence that the estimated coefficients produced by SUR are consistent and unbiased, and (3) when the SUR estimator is used, the RESET test for general model specification fails for more sectors, especially in the employment equation, than when OLS is used.

4.4. The Manufacturing Sector

The two-equation baseline and extended models are also estimated for the ten subsectors of *Manufacturing*, and the results are reported in Tables 3.8 through 3.11 and also in Tables 3.14 (C) and 3.15 (D) for the exchange rate coefficients adjusted for trade shares.

Investigating the manufacturing subsectors is both necessary and important, because, first, a majority of the previous literature focuses only on the manufacturing industries and, hence, may not be able to provide general evidence that applies to all sectors in an economy. By taking one further step to examine the manufacturing subsectors, we will be able to both verify the previous findings and add new evidence to the literature that is obtained on a multi-country and multi-sector basis. Second, *Manufacturing* is considered as the most internationally-involved sector and hence should be more seriously affected than all other sectors as the exchange rate fluctuates. However, due to aggregation bias, the response to real exchange rate variations of the *Manufacturing* sector as a whole may not reflect the responses of its individual subsectors. Therefore, it is important for policy makers to investigate as well the subsector-specific exchange rate impacts, and find out which one is likely to gain and which one to lose as the value of the domestic currency changes. This will help policy makers to tailor the industry policies for each subsector, rather than taking for granted that all manufacturing subsectors are equally responsive to real exchange rate variations and, hence, should share the same policy.

For all the manufacturing subsectors, the error-correction coefficients have the expected sign, i.e., negative, in both the wage and employment equations. The PSS t-test results show that, for half of the subsectors, there is no long-run relationship between real wages or employment and the explanatory variables at the 5% level of significance. At the 10% level, the existence of a long-run relationship is rejected only for *Chemical, rubber, plastics and fuel products*, and *Machinery and equipment* in the wage equation, and for four subsectors in the employment equation. Similar conclusions can be drawn for the extended models with export orientation and import penetration.

Based on the estimation results of the baseline model (Tables 3.8, 3.9, and 3.14 (C)), a real currency depreciation, in general, has a negative impact on real wages for the manufacturing subsectors in both the short and the long run, with the net effects being significant in three in the short run[55]. The exchange rate influences on employment tend to be mixed among these subsectors. Both positive and negative responses of sectoral employment to real exchange rate variations are observed in the short and the long run, although significant effects only occur in the short run. In particular, a real currency depreciation is found to significantly raise employment for two of the ten subsectors, namely, *Chemical, rubber, plastics and fuel products*, and *Basic metals and fabricated metal products*, and reduce it only for *Other non-metallic mineral products*. Given that the numbers of subsectors that are significantly affected by the real exchange rate through the wage and employment channels are the same, and that only *Chemical, rubber, plastics and fuel products* shows significant responses of both its real wage and employment to the real exchange rate, the labor-market adjustments caused by real exchange rate variations tend to occur equally through both

[55] When the wage equation is estimated with nominal wages instead of real wages as the dependent variable, a real currency depreciation is still found to have a negative and significant impact on the nominal wages of eight subsectors in the short run. In the long run, the wage-exchange rate relationship turns positive in all ten subsectors, with significant effects observed in three (i.e., *Chemical, rubber, plastics and fuel products*, *Other non-metallic mineral products*, and *Machinery and equipment*).

channels. Also, just like the *Manufacturing* sector itself, the real wages and employment levels of its subsectors tend to move in opposite directions in response to a real currency depreciation. Specially, the exchange rate effects on the wages and employment of *Chemical, rubber, plastics and fuel products* almost completely offset each other, leaving a close-to-zero impact on total labor compensation in the short run. In the long run, real exchange rate movements tend to have only insignificant effects on both real wages and employment for all subsectors. This finding is consistent with Bahmani-Oskooee et al. (2007) that a real currency depreciation only has a short-run but no long-run effect on employment and real wages for the manufacturing subsectors. As a consequence, all the long-run growth in real profits of the manufacturing subsectors is contributed solely by real value added growth.

Based on the limited evidence here, there seems to be a tendency that only the real wages of the non-durable-goods industries (e.g., *Pulp, paper, paper products, printing and publishing*, *Chemical, rubber, plastics and fuel products*, and *Manufacturing nec.; Recycling*) are significantly responsive to real exchange rate movements, whereas the employment of the durable-goods industries (e.g., *Other non-metallic mineral products*, and *Basic metals and fabricated metal products*) appears to be more likely to be significantly affected. In addition, unlike among the sectors that comprise the total economy, there does not seem to be an inverse relationship between the price-over-cost mark-ups and the wage or employment elasticity with respect to the real exchange rate. For example, neither the real wages nor employment of the three subsectors with the lowest mark-ups, namely, *Machinery and equipment* (0.128), *Textiles, textile products, leather and footwear* (0.12), and *Transport equipment* (0.086), show any significant responses to real exchange rate variations, whereas the subsectors that have the highest mark-ups, including *Other non-metallic mineral products* (0.199), *Chemical, rubber, plastics and fuel products* (0.178), and *Pulp, paper, paper products, printing and publishing* (0.167), are all significantly affected. Hence, consistent with Mo (2009), an industry’s ability to price-to-market is only weakly related to its wage and employment provided that significant exchange rate effects are found for both the medium- and high-markup industries.

In the extended model (Tables 3.10, 3.11, and 3.15 (C)), the exchange rate effects on sectoral real wages and employment work through three channels, namely, export orientation, import penetration, and the "residual" channel that is left over from the other two channels. This subdivision is important in the sense that it allows one to assess the relative importance of each channel in the transmission process of exchange rate variations. As the export orientation and import penetration channels are taken into account, more subsectors now tend to show significant responses of real wages and/or employment to the real exchange rate through different channels. Moreover, the long-run impacts of the real exchange rate also become significant for several subsectors in both the wage and employment cases. When the exchange rate effects through the three channels are looked at closely, there does not seem to be a clear pattern how the two labor market variables are affected by the real exchange rate via the three channels. In other words, a significant exchange rate effect on real wages through the export channel can be either positive or negative, as can the exchange rate effects through the import and residual channels. For employment, the significant exchange rate impacts through both the export and residual channels are positive, except for *Machinery and equipment*, whereas the significant impacts through the import channel can be either positive or negative.

According to the results reported in Table 3.15 (C), the net effects of a real currency depreciation on real wages are negative for all subsectors, with the coefficients being significant for only three and only in the short run. A positive and significant relationship between employment and the real exchange rate is observed in two subsectors in the short run and in only one in the long run. Whereas a real currency depreciation is found to significantly lower the employment level for only one subsector as in the baseline model, namely, *Other non-metallic mineral products*. Therefore, even though significant exchange rate effects are observed for more subsectors as different transmission channels are considered, the number of subsectors that show significant net responses of either real wages or employment is roughly the same as in the baseline case. Moreover, for those subsectors whose real wages or employment are significantly affected in both the baseline and extended models, the estimated exchange rate coefficients, after adjusting for the trade share, export orientation, and import penetration, appear to be very similar to each other in both models. This again suggests that the real exchange rate effects through the three channels tend to cancel out each other in the aggregation process.

Real GDP growth significantly and positively affects the movements of both real wages and employment in the short run. Particularly, in the baseline model, real GDP is an important determinant of short-run employment for all ten subsectors, and also has significant impacts on short-run real wages for seven. The positive relationships between real GDP and the two labor-market variables imply that an output expansion in the total economy will lead to higher demand for labor as well as higher real wages for workers. In the long run, real GDP only significantly affects the real wage of *Transport equipment*, with a 0.607 percent drop in real wage associated with a one percent real GDP growth. This may be attributable to higher inflation which outgrows the nominal wage for this sector. By switching to the extended model with export orientation and import penetration, the importance of real GDP in the determination of both real wages and employment still appears mostly in the short run, whereas the magnitude and significance levels of the impacts on these two labor-market variables of real GDP do not seem to vary considerably relative to the baseline case. The loss of long-run importance of real GDP in the determination of real wages and employment implies that these subsectors may rely less heavily on the domestic demand as they gradually expand exports or shift production abroad in the long run.

According to the RESET and AR (1) test results, our models seem to be well specified for a majority of the subsectors. However, the null hypothesis of appropriate model specification of the RESET test is rejected at the 5% level for two subsectors in both the wage and employment equations, although, the test only fails at the 1% level for *Other non-metallic mineral products* in the employment case. Also, the hypothesis of no serial correlation is rejected at the 5% level for one subsector in each model, and at the 1% level only for *Textiles, textile products, leather and footwear* in the employment equation. A switch from the baseline to the extended model with export orientation and import penetration hardly improves the specification of the model, in the sense that the number of subsectors for which the RESET or AR (1) test fails is, in fact, larger than in the baseline model.

The endogeneity test results (Table 3.5) show that the null hypotheses that the real exchange rate and real GDP are exogenous cannot be rejected at the 5% level for any subsector in the wage case. For employment, the hypothesis that real GDP is exogenous cannot be rejected at the 5% level, while the hypothesis of exogenous real exchange rate is rejected at the 5% percent level for *Machinery and equipment*, and at the 1% level for *Chemical, rubber, plastics and fuel products*.

4.5. Asymmetric Exchange Rate Effects

Firms are likely to adopt different pricing strategies in response to real currency appreciations and depreciations. For example, they may choose to keep the foreign-currency export price fixed, as the domestic currency appreciates, so as to maintain the price competitiveness of their products and their share in the export market. In the case of a domestic currency depreciation, by contrast, lowering the export price in foreign currency terms in order to expand foreign demand and the market share may be a better strategy to take. By adopting different pricing strategies, the profits of a firm are likely to show asymmetric responses to real currency appreciations and depreciations. The results from Chapters 1 and 2 demonstrate that, for some sectors, not only the real profits, but also the real value added of firms tend to increase by slightly more as the domestic currency depreciates than they decrease as the domestic appreciates by the same magnitude. Hence, it may also be the case that real wages and employment would respond asymmetrically to real currency appreciations and depreciations as well.

This hypothesis is tested by constructing a dummy variable, D, which takes a value of 0 in the case of a real currency depreciation and a value of 1, otherwise. This dummy variable and the dummy-interacted real exchange rate are included in the regression as a constant term and an additional explanatory variable, respectively. Next, a t-test for the significance of each of the dummy variables and an F-test for joint significance are performed.

The test results reported in Tables 3.12 (A) and (B) show that, real currency depreciations and appreciations are more likely to have asymmetric effects on employment than on real wages. Among the 13 sectors and multi-sector aggregates, real wages all respond symmetrically to real currency appreciations and depreciations in both the short and the long run. Whereas employment, at the 5% level, tends to drop more as the domestic currency appreciates than it rises as the domestic currency depreciates for *Mining and quarrying* in the long run. The opposite applies to *Mining and quarrying* in the short run, *Non-agriculture business sector* in the long run, and *Total economy* in both the short and the long run. Finally, an F-test for the joint significance of the dummy variables shows that the constant dummy and the dummy-interacted real exchange rates are jointly significant only for the employment of *Mining and quarrying*, and *Total economy*.

Among the ten manufacturing subsectors, asymmetric wage responses to real exchange rate variations only occur in the subsectors *Basic metals and fabricated metal products*, and *Machinery and equipment* at the 5% level of significance. For *Machinery and equipment*, a real currency depreciation tends to reduce real wages by more than they are raised by a real currency appreciation the short run. In addition, the negative and significant estimated coefficients on the constant dummies for these two subsectors imply that the autonomous real wages, i.e., the real wages that are independent of the explanatory variables, are slightly lower when the domestic currency appreciates than when it depreciates. Also, just like for *Manufacturing*, a real currency depreciation tends to raise the short-run employment of *Pulp, paper, paper products, printing and publishing*, and *Machinery and equipment* by a little more than they are reduced by a real currency appreciation. Finally, an F-test for the joint significance of all three dummy variables shows that asymmetric wage responses only exist in *Basic metals and fabricated metal products*, and asymmetric employment responses exist in four, even though the individual dummy variables are, in fact, insignificant in two of these.

Generally speaking, employment is more likely to be asymmetrically affected by real exchange rate movements than are real wages. The magnitude of asymmetry, however, is fairly small, but tends to increase in the long run.

4.6. Regional Disparity of Exchange Rate Impacts

Firms from different regions, due to their specific business traditions and competitive structures, may behave differently in response to exchange rate variations. In this current study, 15 out of the 20 sample countries are located in Europe, and 14 of them are European Union (EU) members. As shown in the previous two chapters, the real profits and real value added of firms from the EU countries, in general, tend to respond to real exchange rate movements in a quite similar fashion as those of firms from the non-EU countries. Hence, it should be reasonable for us to expect the real wages and employment of firms from all sample countries to show similar responses to the real exchange rate as well.

To test for this hypothesis, a EU dummy, which takes a value of 1 if it is a EU member[56], and a value of 0, otherwise, is constructed and interacted with the trade-weighted real exchange rate. When this dummy-interacted real exchange rate is included in the regression, a t-test is employed to test for its significance in the short and the long run, respectively. The test results are reported in Tables 3.15 (A) and (B) for real wages and employment, respectively.

The real exchange rate tends to affect the real wages of firms from both the EU and non-EU countries quite similarly in all sectors. In particular, significantly different wage responses between EU and non-EU firms are only found for the subsector *Other non-metallic mineral products* at the 5% level of significance, with the wages of the EU firms showing relatively weaker responses to real exchange rate variations than those of the non-EU firms. Also, significantly different and also weaker responses of the EU firms to real exchange rate changes occur in three sectors and subsectors in the short run, and in two in the long run. Not surprisingly, except for *Textiles, textile products, leather and footwear*, the remaining three sectors and subsectors, including *Construction*, *Other non-metallic mineral products*, and *Manufacturing nec.; Recycling*, are a non-tradable-good sector and manufacturing subsectors that are the least internationally engaged, respectively. Hence, consistent with the results from the previous two chapters, the employment level of EU firms in the subsector *Manufacturing nec.; Recycling* is inversely affected by a real currency depreciation, whereas the employment of the non-EU firms rises in both the short and the long run as the domestic currency depreciates. Also, there is a tendency for both the real wages and employment of the EU firms to show relatively weaker responses than non-EU firms to real exchange rate movements in non-

[56] Including Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the UK.

tradable-good sectors and manufacturing subsectors that are less internationally engaged.

5. Conclusion

A real depreciation of the domestic currency tends to affect the real wage and employment of a particular sector from two directions. On the one hand, the real currency depreciation reduces the relative price of domestic goods in the export market and, hence, encourages the foreign demand to increase. This higher foreign demand will be met by an output expansion in the domestic country, which tends to push up both domestic employment and real wages. On the other hand, the cost of imported intermediate inputs and, in turn, the marginal cost of production will increase following the domestic currency depreciation. The higher marginal cost will put downward pressure on profits as well as on production and labor demand. The real wage will drop as the demand for labor falls. Thereby, the direction of movements of employment and wages will depend crucially on the relative strengths of the demand and cost effects of the exchange rate.

An evaluation of the exchange rate impacts on real wages and employment shows that a real currency depreciation tends to negatively affect real wages for the non-tradable-good sectors, *Manufacturing*, and some of its subsectors, but positively affect the employment of *Manufacturing* and its subsectors and negatively affect the employment of the non-tradable-good sectors, especially in the short run. In particular, for the *Manufacturing* sector and the subsector *Chemical, rubber, plastics and fuel products*, short-run real wages and employment tend to move in opposite directions as the domestic currency depreciates, thus resulting in close-to-zero movements in total real labor compensation associated with the real exchange rate. For the non-tradable-good sectors, falling real wages associated with a real currency depreciation are observed for four sectors and three multi-sector aggregates in the short run, and also for *Construction*, *Community, social and personal services*, and *Total economy* in the long run. Falling employment only occurs in *Construction*, and *Total services* in both the short and the long run. Consequently, real wages and employment will move in the same direction for *Construction*, and *Total services*, as the exchange rate fluctuates, thus leading to greater exchange rate impacts on total real labor compensation. In addition, there is also a tendency for the real wages and/or employment of the sectors with the lowest price-over-cost mark-ups, including *Manufacturing*, *Construction*, and *Community, social and personal services*, to be significantly affected by and exhibit strong responses to real exchange rate variations.

When the estimation results from all three chapters are combined together[57], one of the key findings is that, even though a real depreciation of the domestic currency is shown to raise real profits for the tradable-good sectors, half of the manufacturing subsectors, *Total economy*, and even two non-tradable-good sectors and two service sector aggregates, this may not serve as a source of confidence for using real currency devaluations to stimulate the economy. By further investigating the exchange rate impacts on real value added and real wages and employment, I find that, even though the percentage changes in real profits and real labor compensation, caused by a one percent real currency depreciation, may not exactly sum to the percentage change in real value added, due to differences in the sample sizes and optimal lag lengths in the four models, it is still quite obvious that, for the two tradable-good sectors, namely, *Agriculture, hunting, forestry and fishing*, and *Manufacturing*, and some of the manufacturing subsectors, a real currency depreciation raises their real value added and/or employment, and lowers their real wages. Also, real wages and employment either move in opposite directions, leaving only a small change in total real labor compensation, or changes in these two variables are very small relative to those in real value added, or they simply show no significant responses to the real exchange rate. Therefore, the profit growth achieved in these sectors and subsectors is driven primarily by real value added growth. For example, a one percent real currency depreciation raises the real profits of *Manufacturing* by 0.541 percent, and reduces its total real labor compensation by 0.001 (= -0.074+0.073) percent in the short run (Table 3.14 (A)). Given that the shares of profits and labor compensation in value added are 0.369 and 0.631, respectively, we can calculate the percentage increase in short-run real value added as

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[57] Since real profits are defined as the difference between real value added (i.e., nominal value added divided by the GDP deflator) and total real labor compensation, to make this comparison, I use the estimation results for real value added, instead of those for value added volumes, over the full sample. The estimation results for real value added are reported in Tables G.3-G.4, and the adjusted exchange rate coefficients are reported in Table G.5 in Appendix G.

0.199 (= 0.541*0.369-0.001*0.631) percent[58], which is close to the adjusted exchange rate coefficient of 0.229 in the value added equation (Table G.5). In the long run, the real value added increase, calculated using the percentage changes in real profits and real labor compensation, is 0.713 (=1.498*0.369 + (0.334-0.081)*0.631) percent (compared to the adjusted exchange rate coefficient of 0.778 reported in Table G.5), to which the contribution of the change in real labor compensation is only 0.16 (= (0.334-0.081)*0.631) percent. Given the positive growth in real profits in both the short and the long run, firms in the *Manufacturing* sector are the gainers of a real currency depreciation.

The responses of the non-tradable-good sectors to a real currency depreciation need to be divided into two cases. For *Finance, insurance, real estate and business services*, *Business sector services*, and *Total services*, a real depreciation of the domestic currency has no significant impact on their real value added, but lowers their real wages in the short run. Hence, the short-run profit increases in these sectors are achieved through real wage drops, rather than through output expansions. The other type of non-tradable-good sectors, including *Construction*, and *Community, social and personal services*, responds to a real currency depreciation by cutting real value added, real wages and employment [59]. For *Construction* in the long run, the real value added contraction outstrips the drop in total real labor compensation, resulting in a fall in real

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[58] For simplicity, express real value added of sector i as the sum of the real profits and real labor compensation of sector i, i.e., $\frac{VA_i}{P} = \frac{\Pi_i}{P} + \frac{LC_i}{P}$. Take the total differentiation and do some simple manipulations:

$$d\left(\frac{VA_i}{P}\right) = d\left(\frac{\Pi_i}{P}\right) + d\left(\frac{LC_i}{P}\right)$$

$$\Rightarrow \frac{d\left(VA_i/P\right)}{VA_i/P} = \frac{d\left(\Pi_i/P\right)}{VA_i/P} + \frac{d\left(LC_i/P\right)}{VA_i/P}$$

$$\Rightarrow d\ln\left(\frac{VA_i}{P}\right) = \frac{d\left(\Pi_i/P\right)/\left(\Pi_i/P\right)}{\left(VA_i/P\right)/\left(\Pi_i/P\right)} + \frac{d\left(LC_i/P\right)/\left(LC_i/P\right)}{\left(VA_i/P\right)/\left(LC_i/P\right)}$$

$$\Rightarrow d\ln\left(\frac{VA_i}{P}\right) = \alpha_{\Pi} * d\ln\left(\frac{\Pi_i}{P}\right) + \alpha_{LC} * d\ln\left(\frac{LC_i}{P}\right)$$

where α_{Π} and α_{LC} are the shares of real profits and total real labor compensation in real value added, respectively.

[59] For *Community, social and personal services*, only real wages fall as the domestic currency depreciates, while both real wages and employment drop for *Construction*.

profits.[60] By contrast, the exchange rate effects on real value added and on total real labor compensation tend to offset each other for the *Construction* sector in the short run and for *Community, social and personal services* in both the short and the long run, leaving an insignificant impact on real profits of the real exchange rate. Since the real value added of the non-tradable-good sectors either drops or is insensitive to a real currency depreciation, whereas their real wages and employment are both likely to fall, they are the losers of the real currency depreciation.

For *Total economy*, a real currency depreciation is associated with profit increases in both the short and the long run. However, the profit growth in these two time periods is achieved through different ways. Particularly, in the short run, the real currency depreciation raises real value added and lowers the real wage. Thus, the profit increase is attributable to both output expansion and cost reduction. In the long run, since neither real value added nor employment is significantly affected by real exchange rate variations, the higher profit is the direct result of a large drop in real wages.

Therefore, for those industrialized countries whose GDP is dominated by service rather than manufacturing output, the use of a real currency depreciation aimed at stimulating the total economy is demonstrated to only benefit the profit-earners (except those in the *Construction* sector) as their real profits increase in both the short and the long run following a real currency depreciation. Workers, or wage-earners, on the contrary, will lose collectively as their real wages fall permanently. As argued by Krugman and Taylor (1978), if the redistribution of income from wage-earners to profit-earners, who have higher marginal propensity to save, leads to over-saving, after a currency depreciation, output is likely to contract. Even though the contractionary effect is not observed in this study, a real currency depreciation is shown to only slightly boost the total real GDP in the short run, and only has a neutral effect in the long run.

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[60] For *Construction*, a one percent real currency depreciation lowers the real profits by 0.191 and 0.886 percent in the short and the long run, respectively, drops in real labor compensation associated with the real currency depreciation are, respectively, 0.275 and 1.024 percent in the short and the long run. Given the profit and labor compensation shares of 0.364 and 0.636, respectively, the short-run decline in real value added is 0.245 (= -0.191*0.364-0.275*0.636) percent and the long-run fall is 0.974 (= -0.886*0.364-1.024*0.636) percent. Thus, real value added drops more than does real labor compensation in both the short and the long run.

For future studies, if data is available, attention should be first focused on how real exchange rate variations affect sectoral real wages in terms of the sector-level, rather than aggregate-level, price index. Measuring the real wage at the price level facing each particular sector will more accurately depict the cost structure for each sector. Thus, decreasing real wages in response to a real currency depreciation may not necessarily occur, given that the prices in each sector may grow at different rates from the general price level.

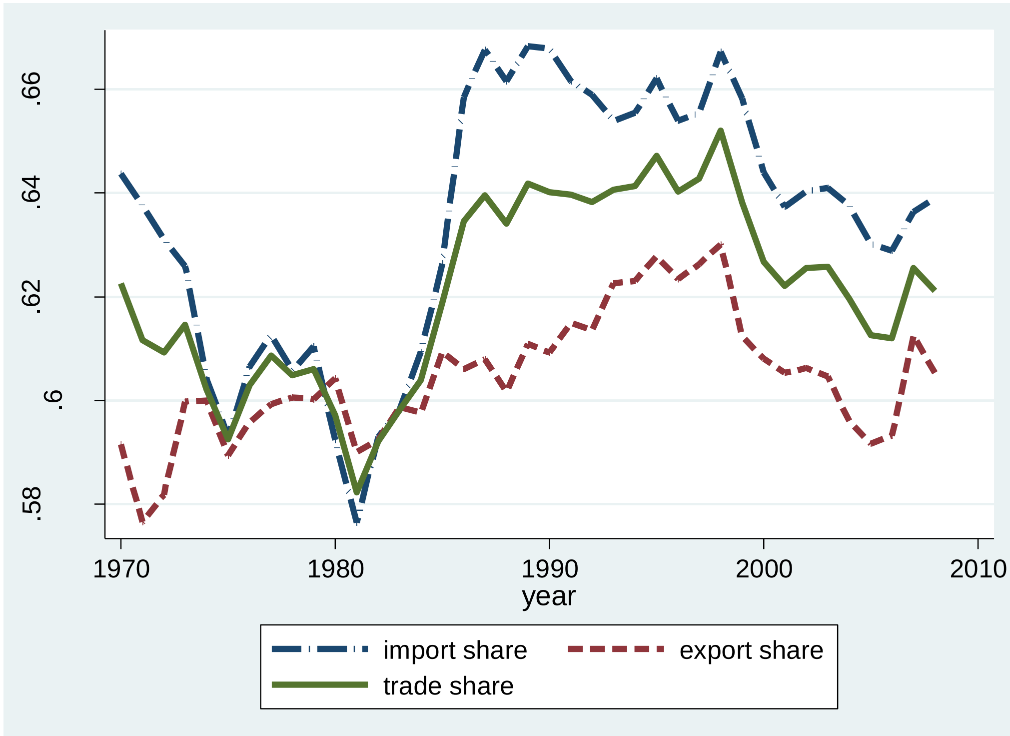
Second, the supply side of the economy should be incorporated in the model and investigated in more detail. A change in the unemployment rate may have different influences on economic activities when an economy is producing at full capacity, i.e., when the natural rate of unemployment (NRU) is achieved, and when it is not. For example, a domestic currency depreciation raises the foreign demand for domestic goods. As a result, both production and demand for labor in the domestic country are likely to increase. If the economy is operating close to full capacity, so that firms have to compete with each other for workers and higher production can only be achieved by incurring a higher unit cost, then nominal wages will increase, so will the output price. If the increase in the output price falls short of the wage increase, then real wages will be pushed up as well. In contrast, if the economy is initially operating at less than full capacity, and workers are willing to work at the going wage, then real wages may stay unchanged. Therefore, to take this situation into account, the NRU must be incorporated in the model as a benchmark. Moreover, the labor supply function of a sector should depend not only on its own real wage, but also on the real wage of other sectors, since the wage level of a smaller sector (e.g., *Manufacturing*) may be affected by that of a larger sector (e.g., *Total services*). This may help explain why the real wages of *Manufacturing* and most of its subsectors fall while the employment levels rise, as the domestic currency depreciates.

Third, it would be interesting to investigate if the four dependent variables in our three models will respond differently to an exchange rate shock if the shock is caused by a fiscal or monetary policy. This could be useful since monetary and fiscal policies, apart from affecting profits, value added, wages and employment through their effects on the exchange rate, may also have a direct and independent impact on those four variables. Hence, it would be helpful to separate the direct effects of monetary and fiscal policies from their indirect effects. Some preliminary results show that if real government spending and the short-term real interest rate are included in the model to examine the effects of fiscal and monetary policies on sectoral real value added, the real value added of most sectors was not significantly responsive to changes in either of the policy variables. Also, these two variables were not significantly correlated with the real exchange rate, either. Therefore, we may expect an exchange rate shock, either truly exogenous or policy-induced, to affect sectoral real value added in the same fashion. Given that it was not a formal study of this topic, and the responses of profits, wages and employment to exchange rate variations that are caused by different factors have not been studied, this topic remains open for future research.

Fourthly, when data is available, it would be very helpful to separate out the impact of the use of imported inputs from the exchange rate effect. This would be an important step because an exchange rate shock can directly affect the cost of imported inputs in domestic currency terms, increasing or decreasing the marginal cost of production as well as the general price level of the domestic country. As the production cost and relative price change, the value added, profits, and labor demand of the domestic firm will change accordingly.

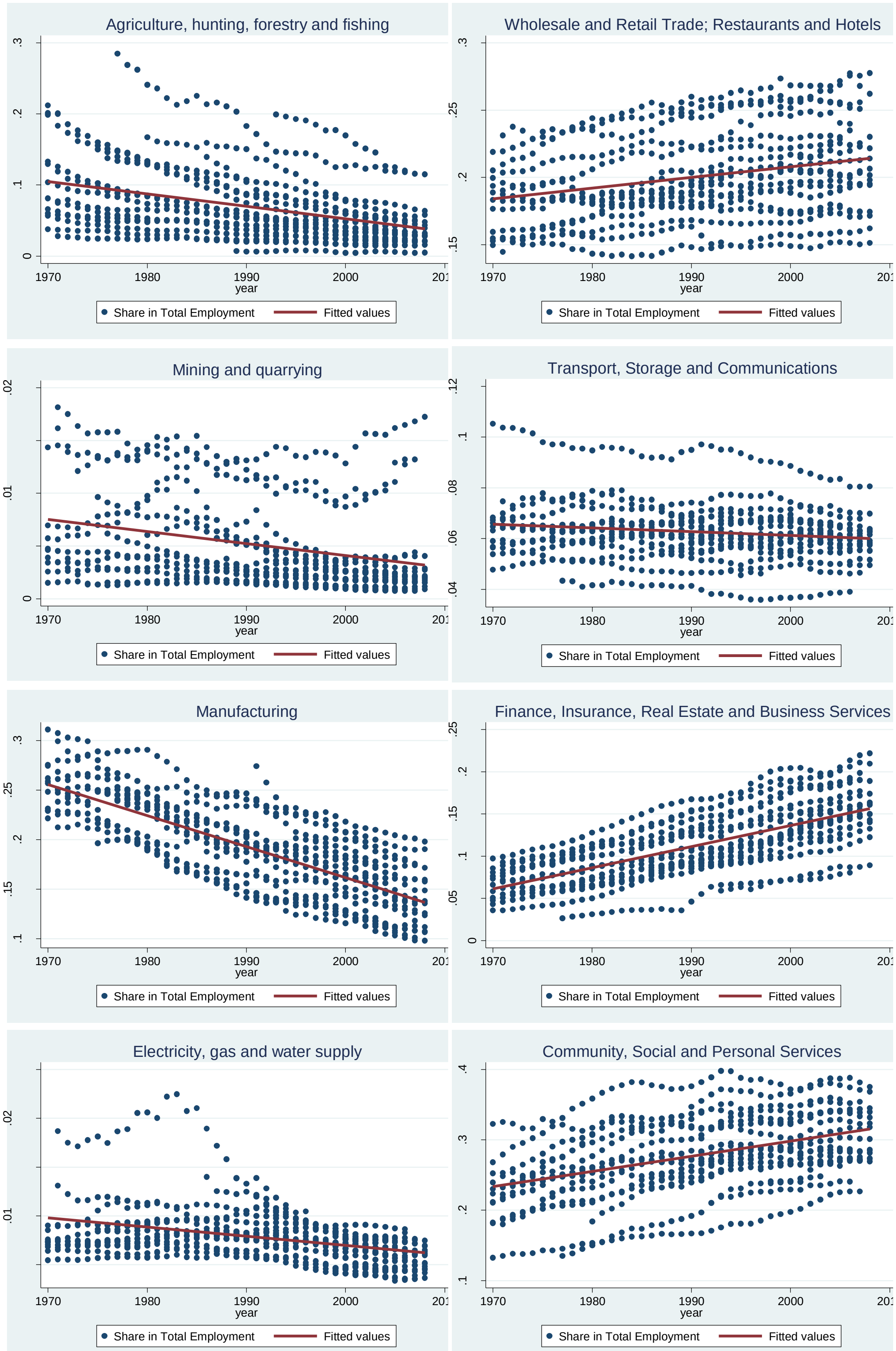
Finally, it may be helpful to also incorporate variables that reflect institutional factors, such as tariffs and government regulations of the product and labor markets, into the model, since these factors may prevent the exchange rate from having significant impacts on sectoral output and employment (Burgess and Knetter, 1998). Moreover, according to Feenstra (1989), a domestic currency depreciation and an equivalent increase in an ad valorem tariff tend to have similar effects on the import price and profits of a firm facing international competition (i.e., the symmetry hypothesis). Therefore, if this hypothesis holds, one will be able to infer the impact of a change in an ad valorem tariff on sectoral profits from the profit-exchange rate relationship examined in this study, and also use the symmetry hypothesis to evaluate the feasibility of a change in the trade policy, in which a tariff is set or changed.

Figure 1.1 Manufacturing shares of total trade, imports and exports



Data source: Sectoral imports and exports data from the *OECD STAN Database for Industrial Analysis,* total imports and exports data from the National Accounts of the OECD database.

Figure 3.1 Share in Total Employment by Sector



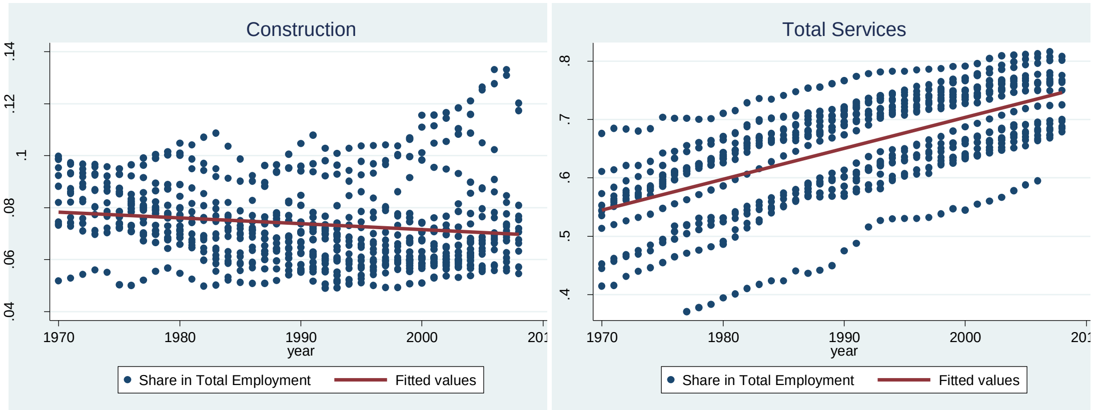
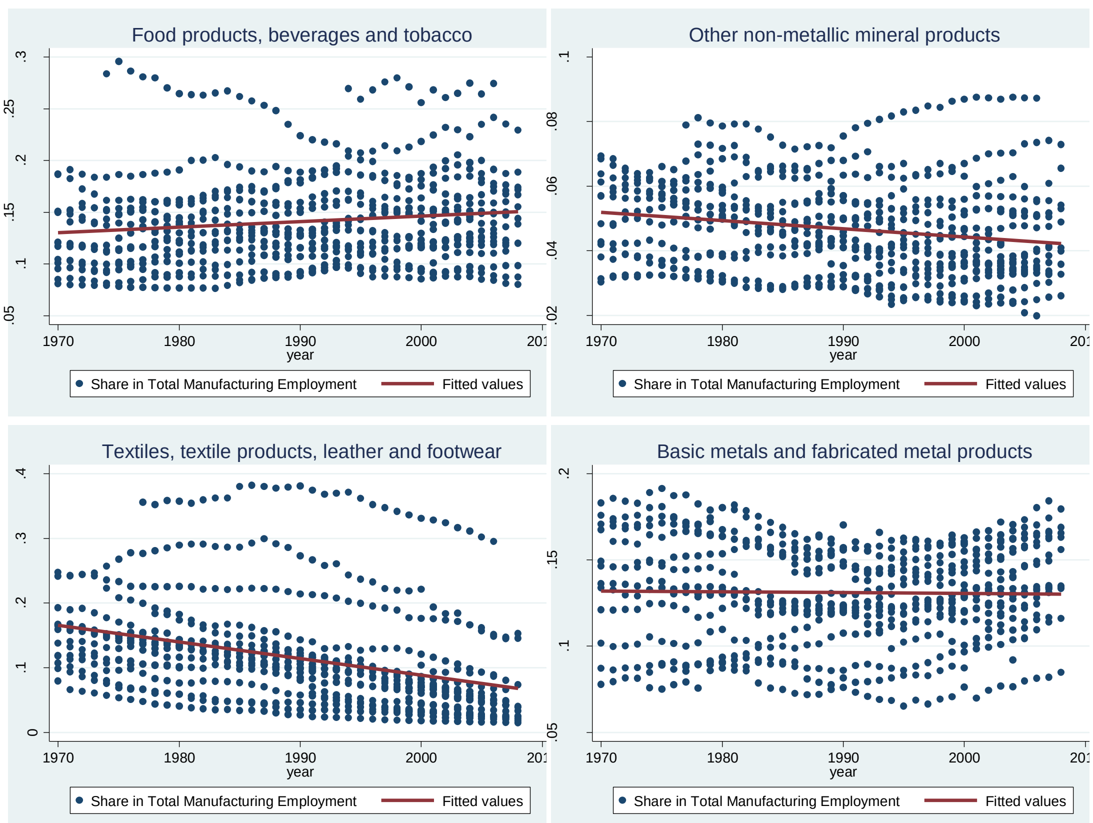


Figure 3.2 Share in Manufacturing Employment by Manufacturing Subsector



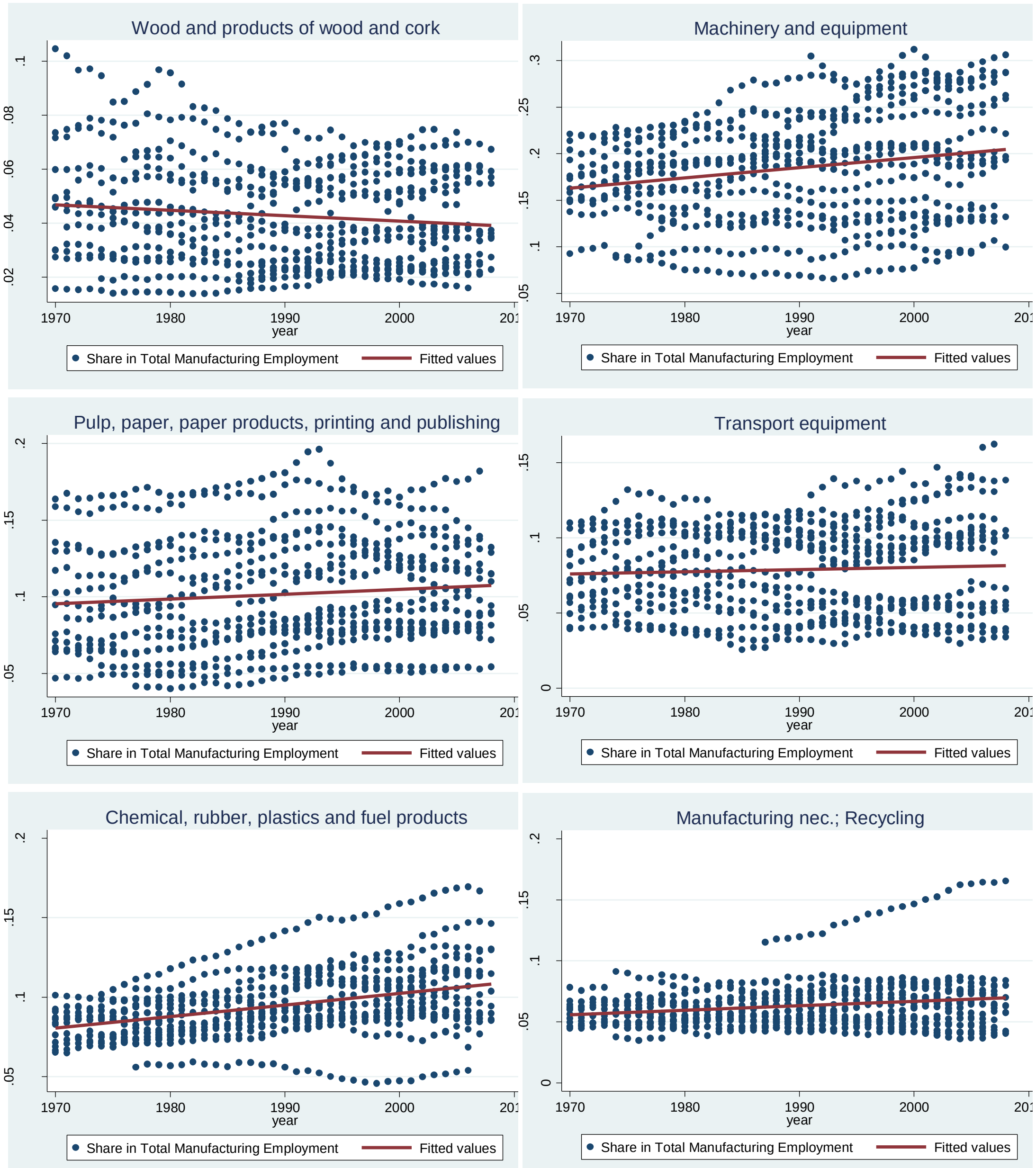

Wood and products of wood and cork
Machinery and equipment
Pulp, paper, paper products, printing and publishing
Transport equipment
Chemical, rubber, plastics and fuel products
Manufacturing nec.; Recycling
year
Share in Total Manufacturing Employment
Fitted values

Table 1 Correlations between Changes in Real Profits, Real Value Added, Total Real Labor Compensation, Real Wage Rate, Employment, and the Real Exchange Rate

AGRICULTURE, HUNTING, FORESTRY AND FISHING						*ELECTRICITY GAS AND, WATER SUPPLY*					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}		$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.98***					$\Delta(va_i - p)_t$	0.75***				
$\Delta(lc_i - p)_t$	0.09**	0.21***				$\Delta(lc_i - p)_t$	-0.05	0.19***			
$\Delta(w_i - p)_t$	0.09**	0.17***	0.73***			$\Delta(w_i - p)_t$	-0.04	0.11***	0.65***		
Δl_{it}	-0.01	0.03	0.28***	-0.45***		Δl_{it}	-0.00	0.12***	0.45***	-0.38***	
$\Delta(e + p^f - p)_t$	0.15***	0.16***	0.01	0.02	-0.03	$\Delta(e + p^f - p)_t$	-0.02	-0.06	-0.14***	-0.06	-0.08**
MINING AND QUARRYING						*CONSTRUCTION*					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}		$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.87***					$\Delta(va_i - p)_t$	0.77***				
$\Delta(lc_i - p)_t$	0.06	0.22***				$\Delta(lc_i - p)_t$	0.30***	0.78***			
$\Delta(w_i - p)_t$	-0.11***	-0.03	0.67***			$\Delta(w_i - p)_t$	0.06	0.38***	0.62***		
Δl_{it}	0.19***	0.30***	0.57***	-0.23***		Δl_{it}	0.32***	0.72***	0.84***	0.09**	
$\Delta(e + p^f - p)_t$	0.05	0.05	-0.04	-0.02	-0.05	$\Delta(e + p^f - p)_t$	-0.08**	-0.13***	-0.19***	-0.11***	-0.18***
MANUFACTURING						*WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS*					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}		$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.81***					$\Delta(va_i - p)_t$	0.820***				
$\Delta(lc_i - p)_t$	0.12***	0.61***				$\Delta(lc_i - p)_t$	0.01	0.50***			
$\Delta(w_i - p)_t$	-0.12***	0.19***	0.62***			$\Delta(w_i - p)_t$	-0.14***	0.26***	0.78***		
Δl_{it}	0.27***	0.59***	0.72***	-0.11***		Δl_{it}	0.20***	0.45***	0.56***	-0.08*	
$\Delta(e + p^f - p)_t$	0.25***	0.14***	-0.06*	-0.02	-0.07*	$\Delta(e + p^f - p)_t$	0.08**	-0.02	-0.15**	-0.10**	-0.14***

TRANSPORT, STORAGE AND COMMUNICATIONS					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.78***				
$\Delta(lc_i - p)_t$	-0.26***	0.30***			
$\Delta(w_i - p)_t$	-0.18***	0.19***	0.67***		
Δl_{it}	-0.09**	0.16***	0.47***	-0.33***	
$\Delta(e + p^f - p)_t$	0.07*	0.02	-0.12***	-0.07*	-0.05

NON-AGRICULTURE BUSINESS SECTOR					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.77***				
$\Delta(lc_i - p)_t$	-0.08*	0.49***			
$\Delta(w_i - p)_t$	-0.29***	0.10*	0.79***		
Δl_{it}	0.23***	0.67***	0.62***	0.02	
$\Delta(e + p^f - p)_t$	0.10**	-0.02	-0.11**	-0.01	-0.12**

FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.90***				
$\Delta(lc_i - p)_t$	0.05	0.45***			
$\Delta(w_i - p)_t$	-0.03	0.24***	0.63***		
Δl_{it}	0.06	0.30***	0.59***	-0.26***	
$\Delta(e + p^f - p)_t$	0.07*	-0.02	-0.18***	-0.12***	-0.09**

BUSINESS SECTOR SERVICES					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.82***				
$\Delta(lc_i - p)_t$	0.02	0.57***			
$\Delta(w_i - p)_t$	-0.10**	0.33***	0.75***		
Δl_{it}	0.14***	0.46***	0.61***	-0.07*	
$\Delta(e + p^f - p)_t$	0.10**	-0.02	-0.18***	-0.12***	-0.12***

COMMUNITY, SOCIAL AND PERSONAL SERVICES					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.35***				
$\Delta(lc_i - p)_t$	0.07*	0.94***			
$\Delta(w_i - p)_t$	0.05	0.76***	0.84***		
Δl_{it}	-0.00	0.47***	0.48***	-0.08**	
$\Delta(e + p^f - p)_t$	-0.01	-0.17***	-0.20***	-0.15***	-0.12***

TOTAL SERVICES					
	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.68***				
$\Delta(lc_i - p)_t$	-0.00	0.73***			
$\Delta(w_i - p)_t$	-0.10***	0.52***	0.82***		
Δl_{it}	0.14***	0.50***	0.55***	-0.03	
$\Delta(e + p^f - p)_t$	0.10**	-0.08**	-0.21***	-0.15***	-0.15***

TOTAL

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.69***				
$\Delta(lc_i - p)_t$	-0.12***	0.62***			
$\Delta(w_i - p)_t$	-0.35***	0.26***	0.78***		
Δl_{it}	0.26***	0.64***	0.60***	-0.04	
$\Delta(e + p^f - p)_t$	0.19***	0.03	-0.19***	-0.14***	-0.13***

Wood and products of wood and cork

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.78***				
$\Delta(lc_i - p)_t$	0.22***	0.62***			
$\Delta(w_i - p)_t$	0.08*	0.27***	0.60***		
Δl_{it}	0.25***	0.52***	0.70***	-0.14***	
$\Delta(e + p^f - p)_t$	0.12***	0.08	-0.03	-0.04	-0.02

Food products, beverages and tobacco

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.69***				
$\Delta(lc_i - p)_t$	-0.05	0.31***			
$\Delta(w_i - p)_t$	-0.03	0.17***	0.70***		
Δl_{it}	-0.07*	0.11***	0.44***	-0.33***	
$\Delta(e + p^f - p)_t$	0.01	-0.01	-0.05	-0.00	-0.09**

Pulp, paper, paper products, printing and publishing

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.86***				
$\Delta(lc_i - p)_t$	0.04	0.38***			
$\Delta(w_i - p)_t$	-0.11***	0.12***	0.66***		
Δl_{it}	0.16***	0.34***	0.58***	-0.23***	
$\Delta(e + p^f - p)_t$	0.17***	0.09**	-0.08**	-0.03	-0.07*

Textiles, textile products, leather and footwear

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.53***				
$\Delta(lc_i - p)_t$	0.08*	0.72***			
$\Delta(w_i - p)_t$	-0.05	0.26***	0.47***		
Δl_{it}	0.13***	0.58***	0.71***	-0.28***	
$\Delta(e + p^f - p)_t$	0.08**	0.10***	0.01	-0.02	-0.00

Chemical, rubber, plastics and fuel products

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.93***				
$\Delta(lc_i - p)_t$	0.05	0.28***			
$\Delta(w_i - p)_t$	-0.08*	0.05	0.59***		
Δl_{it}	0.10***	0.23***	0.56***	-0.35***	
$\Delta(e + p^f - p)_t$	0.16***	0.12***	-0.05	-0.01	-0.04

Other non-metallic mineral products

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.86***				
$\Delta(lc_i - p)_t$	0.17***	0.58***			
$\Delta(w_i - p)_t$	-0.06	0.16***	0.53***		
Δl_{it}	0.25***	0.51***	0.67***	-0.28***	
$\Delta(e + p^f - p)_t$	0.08**	-0.01	-0.14***	-0.03	-0.14***

Transport equipment

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.67***				
$\Delta(lc_i - p)_t$	0.06	0.56***			
$\Delta(w_i - p)_t$	0.05	0.28***	0.56***		
Δl_{it}	0.05	0.43***	0.73***	-0.17***	
$\Delta(e + p^f - p)_t$	-0.02	-0.03	-0.05	-0.01	-0.04

Basic metals and fabricated metal products

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.79***				
$\Delta(lc_i - p)_t$	0.15***	0.51***			
$\Delta(w_i - p)_t$	0.00	0.16***	0.52***		
Δl_{it}	0.16***	0.45***	0.72***	-0.22***	
$\Delta(e + p^f - p)_t$	0.19***	0.16***	-0.05	-0.01	-0.05

Manufacturing nec.; Recycling

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.69***				
$\Delta(lc_i - p)_t$	0.08*	0.64***			
$\Delta(w_i - p)_t$	0.01	0.37***	0.61***		
Δl_{it}	0.06	0.45***	0.67***	-0.19***	
$\Delta(e + p^f - p)_t$	0.05	0.00	-0.05	-0.08*	-0.02

Machinery and equipment

	$\Delta(\pi_i - p)_t$	$\Delta(va_i - p)_t$	$\Delta(lc_i - p)_t$	$\Delta(w_i - p)_t$	Δl_{it}
$\Delta(va_i - p)_t$	0.71***				
$\Delta(lc_i - p)_t$	-0.09**	0.63***			
$\Delta(w_i - p)_t$	-0.05	0.15***	0.44***		
Δl_{it}	0.13***	0.55***	0.72***	-0.30***	
$\Delta(e + p^f - p)_t$	0.09**	0.06*	-0.06	0.01	-0.07

Note: $(\pi_i - p)$ denotes the natural logarithm of the real profits of sector i, $(va_i - p)$ denotes the natural logarithm of real value added of sector i, $(lc_i - p)$ denotes the natural logarithm of real labor compensation of sector i, $(w_i - p)$ denotes the natural logarithm of the real wage of sector i, l_i denotes the natural logarithm of employment of sector i, and $(e + p^f - p)$ denotes the natural logarithm of the real exchange rate.

* The estimated coefficient is significant at the 10 percent significance level.

** The estimated coefficient is significant at the 5 percent significance level.

*** The estimated coefficient is significant at the 1 percent significance level.

Table 1.1 (A) Estimation Results by Sector, Real Profits (baseline model)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
Dependent variable: $\Delta(\pi_i - p)_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	0.642*** (0.171)	0.202 (0.364)	0.855*** (0.227)	-0.504 (0.469)	-0.302 (0.278)
$\Delta(e + p^f - p)_{t-1}$	0.415** (0.167)				
$\Delta(w - p)_t$	-0.531 (0.417)	-2.100*** (0.623)	-1.151** (0.481)	-1.283 (0.881)	0.022 (0.443)
$\Delta(w - p)_{t-1}$					
Δy_t	1.028** (0.451)	3.583*** (1.019)	2.787*** (0.489)	0.087 (0.452)	2.448*** (0.696)
Δy_{t-1}			-0.691*** (0.231)	-1.412** (0.587)	1.481*** (0.340)
$\Delta(\pi_i - p)_{t-1}$				-0.187*** (0.023)	
Long-run coefficients					
$e + p^f - p$	0.661* (0.342)	0.964 (2.926)	2.367*** (0.595)	-0.953 (0.760)	-1.400*** (0.472)
$w - p$	-0.823** (0.311)	1.956 (2.037)	0.085 (0.382)	-0.792 (0.687)	-0.906 (0.532)
y	0.549 (0.606)	-0.728 (1.801)	0.647 (0.386)	0.691* (0.387)	1.924*** (0.243)
Adjustment coefficient $(\tau_i - 1)$	-0.257 (0.046)	-0.116 (0.032)	-0.177 (0.036)	-0.349 (0.060)	-0.276 (0.059)
PSS t-test ($k = 3$)	-5.60^^^	-3.61^^	-4.86^^^	-5.80^^^	-4.69^^^
R^2	0.365	0.331	0.551	0.353	0.383
Number of countries	20	18	20	20	20
Number of observations	607	536	610	597	609
RESET test	0.40	0.41	0.83	36.24[c]	0.00
AR(1) test	-1.01	-0.62	1.30	-0.67	-0.41

Note: Robust-clustered (by country) standard errors in parentheses.

The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on profits.

* The estimated coefficient is significant at the 10 percent significance level.

** The estimated coefficient is significant at the 5 percent significance level.

*** The estimated coefficient is significant at the 1 percent significance level.

The critical value bounds for the PSS t-test at the 5% level of significance are (-2.86, -3.78) for $k = 3$, (-2.86, -3.99) for $k = 4$, and (-2.86, -4.19) for $k = 5$, the bounds at the 10% level are (-2.57, -3.46), (-2.57, -3.66) and (-2.57, -3.86) for k = 3, 4 and 5, respectively (Pesasan et al., (2001), pp.303, Table CII(iii)).

^ Indicates that the statistic lies below the 0.05 lower bound, so a long-run relationship does not exist at the 5% significance level.

^^ Indicates that the statistic falls within the 0.05 bounds, so a long-run relationship may or may not exist at the 5% significance level.

^^^ Indicates that the statistic lies above the 0.05 upper bound, so a long-run relationship exists at the 5% significance level.

a The null hypothesis of appropriate specification can be rejected at the 10 percent significance level, but not at the 5 or 1 percent significance level.

b The specification can be rejected at the 5 percent significance level, but not at the 1 percent significance level.

c The specification can be rejected at the 1 percent significance level.

d The null hypothesis of no first-order autocorrelation can be rejected a the 10 percent significance level, but not at the 5 or 1 percent significance level.

e The null hypothesis of no first-order autocorrelation can be rejected a the 5 percent significance level, but not at the 1 percent significance level.

f The null hypothesis of no first-order autocorrelation can be rejected a the 1 percent significance level.

Table 1.1 (A) Estimation Results by Sector, Real Profits (baseline model) (continued)

Sectors	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*
Dependent variable: $\Delta(\boldsymbol{\pi_i} - \boldsymbol{p})_t$				
Short-run coefficients				
$\Delta(e + p^f - p)_t$	0.204 (0.177)	0.077 (0.157)	0.119* (0.065)	0.048 (0.134)
$\Delta(w - p)_t$	-0.282 (0.284)	-0.718*** (0.245)	0.034 (0.250)	0.136 (0.196)
$\Delta(w - p)_{t-1}$	-0.674*** (0.135)			
Δy_t	2.502*** (0.324)	0.366 (0.430)	0.675*** (0.183)	0.342* (0.185)
$\Delta(\pi_i - p)_{t-1}$			0.055* (0.028)	
Long-run coefficients				
$e + p^f - p$	1.072* (0.592)	0.020 (0.582)	-0.433 (0.478)	0.110 (0.596)
$w - p$	-0.401 (0.407)	0.490 (0.649)	-0.286 (0.513)	0.642 (0.465)
y	1.057** (0.424)	0.517* (0.278)	1.686* (0.930)	0.447 (0.309)
Adjustment coefficient $(\tau_i - 1)$	-0.119 (0.022)	-0.160 (0.038)	-0.070 (0.025)	-0.120 (0.047)
PSS t-test $(k = 3)$	-5.45[^^^]	-4.20[^^^]	-2.84[^]	-2.55[^]
R^2	0.397	0.281	0.288	0.229
Number of countries	20	20	20	20
Number of observations	601	618	605	622
RESET test	0.02	5.45[b]	0.47	30.12[c]
AR(1) test	1.20	1.48	1.06	-2.34[e]

See notes to Table 1.1 (A).

Table 1.1 (B) Estimation Results by Multi-sector Aggregates, Real Profits (baseline model)

Sectors	***Non-agriculture business sector***	***Business sector services***	***Total services***	***Total***
Dependent variable: $\Delta(\boldsymbol{\pi_i - p})_t$				
Short-run coefficients				
$\Delta(e+p^f-p)_t$	0.080 (0.083)	0.129** (0.053)	0.102** (0.042)	0.147*** (0.048)
$\Delta(w-p)_t$	-1.444*** (0.327)	-0.205 (0.217)	-0.145 (0.206)	-0.955*** (0.133)
Δy_t	2.239*** (0.163)	1.118*** (0.176)	1.031*** (0.156)	1.600*** (0.087)
Δy_{t-1}	-0.801*** (0.214)	-0.270** (0.126)	-0.249** (0.108)	-0.441*** (0.083)
$\Delta(\pi_i-p)_{t-1}$	0.153** (0.056)			0.087* (0.044)
Long-run coefficients				
$e+p^f-p$	0.014 (0.391)	0.575 (0.361)	0.350 (0.347)	0.482** (0.202)
$w-p$	-0.247 (0.254)	-0.139 (0.265)	0.115 (0.342)	-0.233* (0.117)
y	1.261*** (0.273)	1.616 (0.680)	1.502** (0.585)	1.079*** (0.114)
Adjustment coefficient $(\tau_i - 1)$	-0.166 (0.039)	-0.073 (0.030)	-0.056 (0.020)	-0.125 (0.023)
PSS t-test $(k=3)$	-4.24^^^	-2.39^	-2.79^	-5.40^^^
R^2	0.757	0.384	0.431	0.779
Number of countries	20	20	20	20
Number of observations	410	608	608	607
RESET test	0.36	0.67	0.00	0.09
AR(1) test	-0.59	-1.28	-0.40	1.23

See notes to Table 1.1 (A).

Table 1.2 Estimation Results by Sector, Real Profits
(extended model with export orientation and import penetration)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Total Services*	*Total Economy*
Dependent variable: $\Delta(\boldsymbol{\pi_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	0.356 (0.314)	0.307 (0.530)	1.554 (0.998)	0.132 (0.115)	0.716 (0.698)
$\Delta(e + p^f - p)_{t-1}$				0.347** (0.162)	
$x * \Delta(e + p^f - p)_t$	0.772* (0.433)	-0.114 (0.039)	-0.444 (0.551)	0.017 (0.054)	0.002 (0.003)
$x * \Delta(e + p^f - p)_{t-1}$	0.560** (0.233)	0.158*** (0.017)		0.257*** (0.087)	
$m * \Delta(e + p^f - p)_t$	-0.241 (0.573)	-0.048 (0.320)	0.085** (0.037)	-0.150 (0.479)	-1.011 (1.252)
$m * \Delta(e + p^f - p)_{t-1}$				-2.312*** (0.774)	
$\Delta(w - p)_t$	-0.519 (0.397)	-2.263*** (0.650)	-1.127** (0.485)	-0.141 (0.215)	-0.944*** (0.135)
Δy_t	1.053** (0.442)	3.514*** (1.019)	2.744*** (0.498)	1.038*** (0.163)	1.597*** (0.085)
Δy_{t-1}			-0.667** (0.238)	-0.264** (0.107)	-0.434*** (0.090)
$\Delta(\pi_i - p)_{t-1}$					0.084* (0.044)
Long-run coefficients					
$e + p^f - p$	0.625 (0.665)	-0.853 (3.425)	2.834 (3.927)	-0.678 (0.934)	-3.938 (3.724)
$x * (e + p^f - p)$	1.744 (1.088)	-0.708*** (0.221)	-0.064 (2.041)	-0.917 (0.712)	-0.023 (0.019)
$m * (e + p^f - p)$	-1.367 (0.957)	2.818* (1.559)	-0.184 (0.151)	7.880 (6.248)	7.898 (6.731)
$w - p$	-0.771** (0.299)	3.002 (2.029)	0.129 (0.354)	0.047 (0.327)	-0.248* (0.122)
y	0.319 (0.632)	0.068 (1.420)	0.526 (0.365)	1.167*** (0.403)	1.084*** (0.104)
Adjustment coefficient $(\tau_i - 1)$	-0.256 (0.046)	-0.140 (0.034)	-0.180 (0.038)	-0.069 (0.021)	-0.131 (0.026)
PSS t-test $(k = 5)$	-5.54^^^	-4.08^^	-4.75^^^	-3.30^^	-5.03^^^
R^2	0.375	0.353	0.555	0.448	0.780
Number of countries	20	18	20	20	20
Number of observations	607	523	610	606	607
RESET test	0.28	0.08	0.95	0.17	0.20
AR(1) test	-1.10	-0.75	1.26	-0.49	1.26

See notes to Table 1.1 (A).
x is sectoral export orientation and m is the rate of import penetration in the domestic market.
The F-test is used to test for the joint significance of all three exchange rate variables in the short and the long run.

Table 1.3 Test for Endogeneity (Real Profits)

Sectors	t-statistics		
	Real exchange rate	Real wage	Real GDP
AGRICULTURE, HUNTING, FORESTRY AND FISHING	0.57	1.46	0.39
MINING AND QUARRYING	1.55	1.38	0.30
MANUFACTURING	2.04*	0.71	1.57
Food products, beverages and tobacco	1.39	0.68	1.04
Textiles, textile products, leather and footwear	0.24	0.65	0.48
Wood and products of wood and cork	1.40	0.26	1.17
Pulp, paper, paper products, printing and publishing	0.22	1.56	0.87
Chemical, rubber, plastics and fuel products	1.29	1.24	1.24
Other non-metallic mineral products	0.76	0.77	0.76
Basic metals and fabricated metal products	0.20	0.20	1.21
Machinery and equipment	0.93	0.20	0.81
Transport equipment	0.84	0.77	1.33
Manufacturing nec.; Recycling	0.00	0.68	0.66
ELECTRICITY GAS AND, WATER SUPPLY	0.54	0.70	2.36**
CONSTRUCTION	1.78*	0.24	3.18***
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	0.26	1.13	0.91
TRANSPORT, STORAGE AND COMMUNICATIONS	0.20	0.96	0.53
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	1.63	0.81	0.10
COMMUNITY, SOCIAL AND PERSONAL SERVICES	0.67	0.62	0.57
NON-AGRICULTURE BUSINESS SECTOR	0.10	1.15	2.10**
BUSINESS SECTOR SERVICES	0.24	0.74	0.53
TOTAL SERVICES	0.96	0.91	0.30
TOTAL	1.47	1.39	1.85*

Note: * The null hypothesis that the particular variable is exogenous is rejected at the 10 percent level of significance.
** The null hypothesis that the particular variable is exogenous is rejected at the 5 percent level of significance.
*** The null hypothesis that the particular variable is exogenous is rejected at the 1 percent level of significance.

Table 1.4 Estimation Results by Manufacturing Sector, Real Profits (baseline model)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: $\Delta(\boldsymbol{\pi_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	-0.269 (0.288)	0.763** (0.316)	1.394** (0.618)	0.951** (0.387)	1.041*** (0.271)
$\Delta(w - p)_t$	-0.414 (0.456)	-0.772 (0.608)	-1.152 (0.848)	-2.056** (0.767)	-0.993** (0.422)
Δy_t	-0.042 (0.408)	2.187** (0.769)	4.091*** (0.828)	3.588*** (0.728)	1.989*** (0.536)
$\Delta(\pi_i - p)_{t-1}$		-0.114*** (0.025)	0.099* (0.052)	0.222** (0.079)	-0.090* (0.045)
Long-run coefficients					
$e + p^f - p$	0.755 (0.657)	3.564** (1.484)	1.136 (1.080)	0.678 (0.470)	2.128** (0.882)
$w - p$	-0.349 (0.485)	-1.262 (0.947)	-0.705 (1.726)	-0.432 (0.446)	0.619 (0.740)
y	0.808* (0.444)	-0.069 (0.926)	0.407 (0.711)	1.035* (0.496)	0.915 (0.530)
Adjustment coefficient $(\tau_i - 1)$	-0.292 (0.059)	-0.195 (0.027)	-0.266 (0.050)	-0.337 (0.044)	-0.201 (0.054)
PSS t-test $(k = 3)$	-4.99^^^	-7.35^^^	-5.34^^^	-7.61^^^	-3.69^^
R^2	0.458	0.242	0.363	0.492	0.351
Number of countries	20	20	20	20	20
Number of observation	608	580	573	600	600
RESET test	162.24[c]	10.17[c]	2.60	4.57[b]	1.41
AR(1) test	3.79[f]	0.29	0.68	0.25	-0.29

See notes to Table 1.1 (A).

Table 1.4 Estimation Results by Manufacturing Sector, Real Profits (baseline model) (continued)

Subsectors	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
Dependent variable: $\Delta(\boldsymbol{\pi_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	0.020 (0.238)	1.670*** (0.335)	0.371 (0.311)	0.223 (1.252)	-0.124 (0.393)
$\Delta(e + p^f - p)_{t-1}$				1.708** (0.621)	
$\Delta(w - p)_t$	-0.763 (0.605)	-1.311** (0.526)	0.215 (0.294)	0.001 (0.945)	-0.511 (0.772)
Δy_t	4.433*** (0.637)	3.705*** (0.838)	3.535*** (0.657)	4.332*** (1.203)	3.380*** (0.932)
$\Delta(\pi_i - p)_{t-1}$				-0.220*** (0.055)	
Long-run coefficients					
$e + p^f - p$	0.343 (0.521)	2.632*** (0.545)	1.350 (1.085)	1.578 (1.264)	0.212 (1.736)
$w - p$	0.001 (0.490)	0.468 (0.366)	1.164 (1.006)	-2.644* (1.273)	0.140 (1.197)
y	0.106 (0.415)	0.126 (0.380)	0.189 (0.620)	1.885*** (0.455)	-0.639 (0.864)
Adjustment coefficient $(\tau_i - 1)$	-0.245 (0.031)	-0.333 (0.046)	-0.224 (0.057)	-0.444 (0.056)	-0.178 (0.024)
PSS t-test $(k = 3)$	-7.98[^^^]	-7.23[^^^]	-3.93[^^^]	-7.89[^^^]	-7.41[^^^]
R^2	0.470	0.568	0.290	0.427	0.228
Number of countries	20	20	20	20	20
Number of observation	602	604	610	550	567
RESET test	1.38	0.46	2.91	6.97[b]	16.59[c]
AR(1) test	0.29	0.98	0.44	-0.37	-1.38

See notes to Table 1.1 (A).

Table 1.5 Estimation Results by Manufacturing Sector, Real Profits (extended model with export orientation and import penetration)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: $\Delta(\boldsymbol{\pi_i - p})_t$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.560 (0.570)	0.221 (1.123)	-1.290** (0.598)	-0.440 (0.326)	-1.412 (1.220)
$x*\Delta(e+p^f-p)_t$	0.210 (0.269)	0.200 (0.543)	2.263*** (0.480)	1.352*** (0.226)	0.463 (0.421)
$m*\Delta(e+p^f-p)_t$	0.013 (0.112)	0.077 (0.228)	0.119 (0.108)	-0.109*** (0.026)	0.587** (0.257)
$\Delta(w-p)_t$	-0.401 (0.447)	-0.768 (0.591)	-1.242 (0.824)	-2.148** (0.765)	-0.930** (0.395)
Δy_t	-0.046 (0.418)	2.178** (0.815)	4.510*** (0.925)	3.639*** (0.766)	2.084*** (0.554)
$\Delta(\pi_i-p)_{t-1}$		-0.117*** (0.025)	0.095* (0.050)	0.216** (0.078)	-0.095** (0.041)
Long-run coefficients					
$e+p^f-p$	1.079 (1.398)	5.156 (3.206)	-1.735 (2.066)	-1.571** (0.608)	7.447* (3.658)
$x*(e+p^f-p)$	-0.104 (0.702)	-0.999 (1.158)	1.921* (0.984)	1.994*** (0.640)	-0.819 (0.950)
$m*(e+p^f-p)$	-0.235 (0.366)	0.371 (0.672)	0.272 (0.185)	0.030 (0.079)	-1.510 (0.943)
$w-p$	-0.289 (0.518)	-1.055 (0.953)	-0.942 (1.812)	-0.798* (0.408)	0.892 (0.799)
y	0.782* (0.422)	-0.164 (0.981)	0.414 (0.675)	1.183** (0.450)	0.754 (0.476)
Adjustment coefficient (τ_i-1)	-0.294 (0.061)	-0.195 (0.029)	-0.264 (0.052)	-0.334 (0.047)	-0.211 (0.052)
PSS t-test $(k=3)$	-4.86^^^	-6.73^^^	-5.04^^^	-7.08^^^	-4.02^^^
R^2	0.460	0.244	0.386	0.518	0.370
Number of countries	20	20	20	20	20
Number of observation	608	580	573	600	600
RESET test	181.80[c]	10.86[c]	1.30	1.53	0.12
AR(1) test	3.79[f]	0.29	0.29	-0.52	-0.28

See notes to Tables 1.1 (A) and 1.2.

Table 1.5 Estimation Results by Manufacturing Sector, Real Profits (extended model with export orientation and import penetration) (continued)

Subsectors	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
Dependent variable: $\Delta(\boldsymbol{\pi_i - p})_t$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.475 (0.560)	-0.066 (1.198)	1.594 (1.387)	-2.120 (2.773)	-0.488 (0.764)
$\Delta(e+p^f-p)_{t-1}$				1.696** (0.589)	
$x*\Delta(e+p^f-p)_t$	1.003 (0.721)	1.367 (0.824)	-0.461 (0.542)	0.736 (0.861)	-0.873 (1.052)
$m*\Delta(e+p^f-p)_t$	-0.202 (0.767)	-0.155 (0.102)	-0.073 (0.069)	0.028 (0.253)	0.945 (0.881)
$\Delta(w-p)_t$	-0.831 (0.599)	-1.271** (0.531)	0.218 (0.291)	-0.134 (0.973)	-0.492 (0.771)
Δy_t	4.561*** (0.645)	3.616*** (0.832)	3.510*** (0.716)	4.098*** (1.228)	3.380*** (0.959)
$\Delta(\pi_i-p)_{t-1}$				-0.221*** (0.056)	
Long-run coefficients					
$e+p^f-p$	-2.579* (1.390)	3.003 (2.202)	5.941 (3.511)	0.111 (1.790)	-0.471 (3.096)
$x*(e+p^f-p)$	3.842 (2.232)	0.084 (1.405)	-1.731 (1.361)	0.918 (0.704)	-0.196 (4.269)
$m*(e+p^f-p)$	0.482 (2.317)	-0.190 (0.120)	-0.247 (0.240)	-0.310 (0.260)	0.554 (3.597)
$w-p$	-0.238 (0.457)	0.557 (0.363)	1.118 (0.977)	-2.459* (1.344)	0.093 (1.243)
y	0.205 (0.393)	0.058 (0.334)	0.155 (0.672)	1.713*** (0.508)	-0.758 (1.126)
Adjustment coefficient (τ_i-1)	-0.250 (0.031)	-0.334 (0.048)	-0.222 (0.056)	-0.445 (0.057)	-0.178 (0.024)
PSS t-test $(k=3)$	-7.94^^^	-6.99^^^	-3.98^^	-7.86^^^	-7.42^^^
R^2	0.474	0.571	0.292	0.432	0.231
Number of countries	20	20	20	20	20
Number of observation	602	604	610	552	567
RESET test	1.42	0.46	2.18	5.05[b]	18.76[c]
AR(1) test	0.17	0.91	0.34	-0.23	-1.39

See notes to Tables 1.1 (A) and 1.2.

Table 1.6 Asymmetric Effects of the Exchange Rate, Real Profits

Sectors	$\Delta(e+p^f-p)_t$	$D*\Delta(e+p^f-p)_t$	$e+p^f-p$	$D*(e+p^f-p)$	D	F statistic
AGRICULTURE, HUNTING, FORESTRY AND FISHING	0.403	0.002	0.620*	0.040*	-0.008	5.03***
MINING AND QUARRYING	-0.094	-0.000	0.121	0.083	-0.012	0.26
MANUFACTURING	1.024***	-0.010**	2.343***	-0.046	-0.017	4.36**
ELECTRICITY GAS AND, WATER SUPPLY	-0.310	0.016	-1.077	0.065	0.076	0.68
CONSTRUCTION	-0.451	0.010**	-1.286**	0.019	0.017	2.12
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	0.345*	-0.010*	1.190**	-0.086	-0.022	2.86*
TRANSPORT, STORAGE AND COMMUNICATIONS	-0.041	-0.000	-0.099	0.013	-0.007	0.75
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	0.223**	-0.002	-0.051	-0.070*	-0.003	2.64*
COMMUNITY, SOCIAL AND PERSONAL SERVICES	0.172	0.002	0.303	-0.062	0.013	2.15
NON-AGRICULTURE BUSINESS SECTOR	0.040	0.002	-0.038	0.014	0.003	0.36
BUSINESS SECTOR SERVICES	0.199**	-0.004*	0.706*	-0.060	-0.008	1.34
TOTAL SERVICES	0.171**	-0.003*	0.577	-0.067*	-0.005	1.76
TOTAL	0.170***	-0.001	0.537***	-0.017	-0.004	1.04
Manufacturing Subsectors						
Food products, beverages and tobacco	0.247	-0.011*	0.950	-0.053**	-0.003	2.86*
Textiles, textile products, leather and footwear	1.174	0.021	3.589**	0.111	0.100	0.36
Wood and products of wood and cork	1.285	-0.032**	1.101	-0.051	-0.049	2.50*
Pulp, paper, paper products, printing and publishing	1.042***	-0.004	0.852	-0.032	-0.013	0.90
Chemical, rubber, plastics and fuel products	0.890*	-0.007	1.907*	-0.010	-0.029	2.01
Other non-metallic mineral products	0.270	0.002	0.531	-0.009	0.021	0.41
Basic metals and fabricated metal products	2.093***	-0.025**	2.669***	-0.073**	-0.049*	2.93*
Machinery and equipment	0.209	0.006	1.123	0.051	0.013	0.51
Transport equipment	0.134	-0.022	1.599	-0.073	-0.080	0.60
Manufacturing nec.; Recycling	-0.023	-0.002	0.124	0.003	0.004	0.07

Note: $D=0$ if $\Delta\left(ep^f/p\right)>0$ and $D=1$ otherwise . Standard errors in parentheses. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on profits.

* The t- statistic or the F statistic for a joint test of zero coefficients on all three dummy variables is significant at the 10 percent significance level.

** The t- statistic or the F statistic for a joint test of zero coefficients on all three dummy variables is at the 5 percent significance level.

*** The t- statistic or the F statistic for a joint test of zero coefficients on all three dummy variables is significant at the 1 percent significance level.

Table 1.7 Response to Exchange Rate Movements of EU and Non-EU Countries, Real Profits

Sectors	Short run		Long run	
	$\Delta(e+p^f-p)_t$	$EU*\Delta(e+p^f-p)_t$	$e+p^f-p$	$EU*(e+p^f-p)$
AGRICULTURE, HUNTING, FORESTRY AND FISHING	1.285***	-0.312	0.936	-0.355
MINING AND QUARRYING	0.008	0.245	3.054	-2.967
MANUFACTURING	0.714***	0.193	1.853*	0.694
ELECTRICITY GAS AND, WATER SUPPLY	-0.493	-0.035	0.322	-1.698*
CONSTRUCTION	-0.651**	0.467	-1.668*	0.351
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	0.064	0.189	-0.451	1.993
TRANSPORT, STORAGE AND COMMUNICATIONS	0.375	-0.396	0.061	-0.047
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	0.007	0.155	-1.610	1.613
COMMUNITY, SOCIAL AND PERSONAL SERVICES	0.154	-0.142	0.270	-0.207
NON-AGRICULTURE BUSINESS SECTOR	0.089	-0.011	0.284	-0.349
BUSINESS SECTOR SERVICES	0.074	0.077	-0.514	1.429
TOTAL SERVICES	0.082	0.030	-0.828	1.568*
TOTAL	0.142**	0.007	0.122	0.472
Manufacturing Subsectors				
Food products, beverages and tobacco	-0.063	-0.293	1.550*	-1.092
Textiles, textile products, leather and footwear	0.051	0.937	5.511***	-2.835
Wood and products of wood and cork	1.538	-0.172	-0.666	2.520
Pulp, paper, paper products, printing and publishing	0.889*	0.078	0.897	-0.299
Chemical, rubber, plastics and fuel products	1.111	-0.092	1.973*	0.213
Other non-metallic mineral products	-0.387	0.559	-0.042	0.539
Basic metals and fabricated metal products	1.636***	0.033	3.304***	-0.919
Machinery and equipment	0.703	-0.444	1.032	0.467
Transport equipment	2.662**	-0.993	0.801	1.083
Manufacturing nec.; Recycling	0.282	-0.669	4.268**	-6.131**

Note: *EU* = 1 if the country is a EU member (including Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, the UK), *EU* = 0 otherwise. The base includes six countries, namely, Australia, Canada, Japan, New Zealand, Norway, and the US. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on profits.

* The estimated coefficient is significant at the 10 percent significance level.

** The estimated coefficient is significant at the 5 percent significance level.

*** The estimated coefficient is significant at the 1 percent significance level.

Table 2.1 Average Sectoral Value added Shares and Average Trade Shares

(A) Sectors and Multi-sector Aggregates

Sectors	Share in total GDP (%)	Price-over-cost markups	Share in international trade (%)	Export share of production (%)	Import penetration (%)
AGRICULTURE, HUNTING, FORESTRY AND FISHING	2.28	0.687	2.58	15.97	19.25
INDUSTRY INCLUDING ENERGY	**21.46**	**0.187**	**67.95**	**41.52**	**41.65**
MINING AND QUARRYING	2.61	0.969	5.08	*27.26*	55.78
MANUFACTURING	16.50	0.137	62.17	37.67	38.61
ELECTRICITY GAS AND, WATER SUPPLY	2.35	0.626	*0.7*	1.90	
CONSTRUCTION	5.18	0.176			
TOTAL SERVICES	**69.98**	**0.362**	**22.17**	9.10	8.33
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	14.57	0.332			
TRANSPORT, STORAGE AND COMMUNICATIONS	6.92	0.277			
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	25.83	0.762			
COMMUNITY, SOCIAL AND PERSONAL SERVICES	22.71	0.161			
NON-AGRICULTURE BUSINESS SECTOR	**83.35**	0.271			
BUSINESS SECTOR SERVICES	**47.27**	0.468			
TOTAL ECONOMY	**100**	0.289	**100**	**37.40**	**37.57**

(B) Manufacturing Subsectors

Subsectors of Manufacturing	Share in total Manufacturing value added (%)	Price-over-cost markups	Share in international trade (%)	Export share of production (%)	Import penetration (%)
Food products, beverage and tobacco	11.74	0.132	6.50	21.53	18.07
Textiles, textile products, leather and footwear	4.83	0.120	5.13	49.38	55.57
Wood and products of wood and cork	2.65	0.130	1.28	23.32	22.36
Pulp, paper, paper products, printing and publishing	11.76	0.167	3.29	22.52	18.86
Chemical, rubber, plastics and fuel products	15.84	0.178	11.29	39.86	-2.24
Other non-metallic mineral products	3.67	0.199	1.11	17.31	18.23
Basic metals and fabricated metal products	12.87	0.134	6.62	31.66	33.52
Machinery and equipment	20.90	0.128	15.90	53.60	60.87
Transport equipment	11.10	0.086	9.15	51.43	59.55
Manufacturing nec.; Recycling	4.60	0.149	1.81	29.68	35.12
Total *Manufacturing*	**100**		**62.17**		

Note: (1) The average sectoral value added shares are calculated using value added data from the OECD STAN Database for Industrial Analysis during the period 1970-2008.

(2) The price-over-cost mark-up is a measure of the competitive structure of a sector, with a higher markup indicating a lower level of competition. It is calculated according to the following formula:

$$\text{Price-over-cost markup} = \frac{\text{Production}}{\text{Total costs}} - 1 = \frac{\text{Profits}}{\text{Production} - \text{Profits}}$$

where $\text{Profits} = \text{Value added} - \text{Labor compensation}$. Data for production, value added, and labor compensation is obtained from the OECD STAN Database for Industrial Analysis. Production data, however, is not available for Australia, and for Ireland in most sectors.

(3) The average trade share is calculated as the share of sectoral trade (exports plus imports) in total trade of goods and services for each sample country during the sample period 1970-2008, and is then averaged across all the sample countries. The sectoral exports and imports data for Agriculture, hunting, forestry and fishing, Mining and quarrying, and Manufacturing are obtained from the OECD STAN Database for Industrial Analysis (i.e., the STAN variables EXPO and IMPO), and data for total and service exports and imports are obtained in the National Accounts of the OECD database. The average trade share for *Electricity, gas and water supply* is calculated as the share for Industry including energy minus the shares for Mining and quarrying, and Manufacturing.

(4) Data for sectoral exports, imports and production comes from the OECD STAN Indicators Database (i.e., the STAN variables EXPO and PROD). However, no production data is available for Australia and Ireland in all sectors, and for France and Portugal in the *Mining and quarrying* sector. Import penetration is calculated as sectoral imports divided by sectoral production plus imports minus exports. The export share of production and import penetration are calculated without Belgium for *Mining and quarrying*, and without Japan for *Total economy*. The export shares of these two countries in these two sectors are so high that the average will be significantly distorted,

(5) Both the trade share and export share of production of Total services are calculated using data from Trade in services by category of service (2000-2008) in the OECD Database as well as production data from the OECD STAN Database for Industrial Analysis. Both shares are calculated excluding Japan, whose export and import shares are so high that the average levels are significantly distorted.

Table 2.2 (A) Estimation Results by Sector, Value Added Volumes (baseline model)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
Dependent variable: $\Delta \boldsymbol{valk_{it}}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	0.039 (0.117)	-0.302 (0.198)	0.191*** (0.043)	-0.095 (0.123)	-0.124 (0.133)
$\Delta(e+p^f-p)_{t-1}$			0.160** (0.056)		-0.181** (0.078)
Δy_t	-0.274* (0.137)	0.535 (0.449)	0.791*** (0.155)	0.209 (0.189)	1.096*** (0.332)
Δy_{t-1}					0.540* (0.267)
$\Delta(w-p)_t$	0.253 (0.166)	0.196 (0.263)	0.033 (0.083)	-0.314 (0.183)	-0.041 (0.194)
$\Delta valk_{i,t-1}$	-0.221*** (0.046)		0.125** (0.053)	-0.090** (0.034)	0.133* (0.071)
Long-run coefficients					
$e+p^f-p$	0.943** (0.426)	-0.111 (1.539)	2.475** (0.867)	-1.351*** (0.418)	-0.978*** (0.309)
y	-0.471 (0.439)	-2.115* (1.172)	-0.695 (0.506)	-0.444 (0.380)	0.974** (0.379)
$w-p$	-0.124 (0.341)	1.753 (1.336)	1.412* (0.748)	0.290 (0.343)	-1.129** (0.415)
Adjustment coefficient $(\tau_i - 1)$	-0.122 (0.023)	-0.082 (0.011)	-0.051 (0.014)	-0.142 (0.027)	-0.121 (0.026)
PSS t-test $(k=3)$	-5.38^^^	-7.13^^^	-3.67^^	-5.25^^^	-4.60^^^
R^2	0.277	0.311	0.580	0.230	0.409
Number of countries	20	18	20	20	20
Number of observation	578	517	570	567	577
RESET test	9.57[c]	0.09	0.08	0.00	0.00
AR(1) test	-1.19	-0.70	0.83	-0.81	-1.00

Note: Robust-clustered (by country) standard errors in parentheses. *Valk* denotes the volume of value added.

The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on real value added.

* The estimated coefficient is significant at the 10 percent significance level.

** The estimated coefficient is significant at the 5 percent significance level.

*** The estimated coefficient is significant at the 1 percent significance level.

The critical value bounds for the PSS t-test at the 5% level of significance are (-2.86, -3.78) for $k=3$, (-2.86, -3.99) for $k=4$, and (-2.86, -4.19) for $k=5$, the bounds at the 10% level are (-2.57, -3.46), (-2.57, -3.66) and (-2.57, -3.86) for k = 3, 4 and 5, respectively (Pesasan et al., (2001), pp.303, Table CII(iii)).

^ Indicates that the statistic lies below the 0.05 lower bound, so a long-run relationship does not exist at the five percent significance level.

^^ Indicates that the statistic falls within the 0.05 bounds, so a long-run relationship may or may not exist at the five percent significance level.

^^^ Indicates that the statistic lies above the 0.05 upper bound, so a long-run relationship exists at the five percent significance level.

a The null hypothesis of appropriate specification can be rejected at the 10 percent significance level, but not at the 5 or 1 percent significance level.

b The specification can be rejected at the 5 percent significance level, but not at the 1 percent significance level.

c The specification can be rejected at the 1 percent significance level.

d The null hypothesis of no first-order autocorrelation can be rejected a the 10 percent significance level, but not at the 5 or 1 percent significance level.

e The null hypothesis of no first-order autocorrelation can be rejected a the 5 percent significance level, but not at the 1 percent significance level.

f The null hypothesis of no first-order autocorrelation can be rejected a the 1 percent significance level.

Table 2.2 (A) Estimation Results by Sector, Value Added Volumes (baseline model) (continued)

Sectors	***Wholesale and retail trade; Restaurants and hotels***	***Transport, storage and communication***	***Finance, insurance, real estate and business services***	***Community social and personal services***
Dependent variable: $\Delta \boldsymbol{valk_{it}}$				
Short-run coefficients				
$\Delta(e+p^f-p)_t$	-0.022 (0.077)	0.040 (0.043)	-0.019 (0.048)	-0.032 (0.032)
Δy_t	1.055*** (0.160)	0.497*** (0.095)	0.158* (0.082)	0.166*** (0.033)
$\Delta(w-p)_t$	0.177 (0.140)	0.151 (0.091)	0.219 (0.183)	0.063 (0.042)
$\Delta valk_{i,t-1}$				0.152* (0.080)
Long-run coefficients				
$e+p^f-p$	0.525 (0.868)	-0.197 (0.657)	0.168 (0.184)	-0.687* (0.392)
y	2.448 (1.389)	0.297 (0.890)	0.795*** (0.221)	1.131*** (0.350)
$w-p$	-0.781 (0.855)	0.194 (1.030)	-0.484 (0.354)	-0.186 (0.412)
Adjustment coefficient (τ_i-1)	-0.039 (0.018)	-0.036 (0.019)	-0.070 (0.017)	-0.041 (0.014)
PSS t-test $(k=3)$	-2.21^	-1.95^	-4.06^^^	-2.91^^
R^2	0.467	0.414	0.346	0.518
Number of countries	20	20	20	20
Number of observation	561	561	595	572
RESET test	2.12	0.12	0.85	0.10
AR(1) test	2.66[f]	1.06	0.14	-0.72

See notes to Table 2.2 (A).

Table 2.2 (B) Estimation Results by Multi-Sector Aggregate, Value Added Volumes (baseline model)

Sectors	***Non-agriculture business sector***	***Business sector services***	***Total services***	***Total Economy***
Dependent variable $\Delta valk_{it}$				
Short-run coefficients				
$\Delta(e+p^f-p)_t$	0.099** (0.037)	-0.001 (0.039)	-0.015 (0.029)	0.053* (0.025)
Δy_t	0.497*** (0.110)	0.354*** (0.085)	0.171*** (0.046)	
Δun_t			0.103*** (0.035)	-0.043*** (0.011)
$\Delta(w-p)_t$	0.051 (0.041)	0.222 (0.143)	0.197* (0.109)	0.144* (0.071)
$\Delta valk_{i,t-1}$	0.290*** (0.051)	0.152** (0.062)		0.137*** (0.045)
Long-run coefficients				
$e+p^f-p$	0.819* (0.415)	0.181 (0.222)	-0.185 (0.399)	0.913 (0.642)
y	0.061 (0.305)	0.860*** (0.248)	1.020 (0.297)	
un				0.029 (0.096)
$w-p$	-0.062 (0.342)	-0.299 (0.388)	-0.450 (0.643)	-0.009 (0.517)
Adjustment coefficient (τ_i-1)	-0.077 (0.026)	-0.064 (0.025)	-0.032 (0.019)	-0.039 (0.014)
PSS t-test $(k=3)$	-2.95^^	-2.55^	-1.64^	-2.82^
R^2	0.615	0.510	0.521	0.638
Number of countries	20	20	20	20
Number of observations	397	578	572	517
RESET test	7.65[b]	2.61	2.43	0.63
AR(1) test	0.74	-0.10	3.17[f]	0.83

See notes to Table 2.2 (A). *un* denotes the natural logarithm of the unemployment rate.

Table 2.3 Estimation Results by Sector, Value Added Volumes (extended model with export orientation and import penetration)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Total services*	*Total economy*
Dependent variable: $\Delta valk_{it}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.364 (0.264)	-0.255 (0.311)	-0.077 (0.358)	-0.144 (0.103)	-0.630 (0.892)
$x*\Delta(e+p^f-p)_t$	-.240 (0.266)	-0.018 (0.015)	0.193 (0.184)	-0.088 (0.062)	-0.004 (0.004)
$x*\Delta(e+p^f-p)_{t-1}$		-0.022*** (0.006)			
$m*\Delta(e+p^f-p)_t$	0.819* (0.430)	-0.000 (0.238)	-0.046** (0.018)	0.777 (0.553)	1.235 (1.586)
$m*\Delta(e+p^f-p)_{t-1}$			0.056** (0.021)		
Δy_t	-0.339** (0.140)	0.440 (0.443)	0.805*** (0.156)	0.172*** (0.046)	
Δun_t				0.099** (0.035)	-0.043*** (0.011)
$\Delta(w-p)_t$	0.225 (0.161)	0.221 (0.220)	0.025 (0.078)	0.201* (0.109)	0.145* (0.072)
$\Delta valk_{i,t-1}$	-0.228*** (0.048)		0.114* (0.055)		0.141*** (0.047)
Long-run coefficients					
$e+p^f-p$	1.575* (0.804)	-2.535 (1.793)	1.702 (5.914)	-1.678 (1.105)	3.013 (5.688)
$x*(e+p^f-p)$	-1.811 (1.628)	-0.240** (0.100)	1.329 (3.140)	-0.988 (0.654)	0.007 (0.027)
$m*(e+p^f-p)$	0.522 (2.192)	2.385*** (0.622)	-0.737* (0.402)	8.783 (5.839)	-3.715 (9.952)
y	-0.436 (0.464)	-2.099* (1.187)	-0.630 (0.499)	1.142 (0.387)	
un					0.022 (0.094)
$w-p$	-0.134 (0.326)	2.579* (1.321)	1.595** (0.758)	-0.478 (0.664)	-0.070 (0.484)
Adjustment coefficient (τ_i-1)	-0.125 (0.020)	-0.088 (0.015)	-0.050 (0.014)	-0.031 (0.021)	-0.042 (0.014)
PSS t-test $(k=5)$	-6.21[^^^]	-5.73[^^^]	-3.64[^^]	-1.49[^]	-3.02[^^]
R^2	0.287	0.287	0.582	0.525	0.641
Number of countries	20	18	20	20	20
Number of observation	578	506	570	572	517
RESET test	10.35[c]	0.03	0.04	3.75[a]	1.07
AR(1) test	-1.22	-0.92	0.98	2.98[f]	0.80

See notes to Table 2.2 (A). *un* denotes the natural logarithm of the unemployment rate.
x is sectoral export orientation and *m* is the rate of import penetration in the domestic market.
The F-test is used to test for the joint significance of all three exchange rate variables in the short and the long run.

Table 2.4 Test for Endogeneity, Value Added Volumes

Sectors	t-statistics		
	Real Exchange rate	Real GDP	Real Wage
AGRICULTURE, HUNTING, FORESTRY AND FISHING	0.57	1.57	0.22
MINING AND QUARRYING	0.35	1.43	0.57
MANUFACTURING	0.26	0.85	1.43
Food products, beverages and tobacco	0.67	2.07*	1.35
Textiles, textile products, leather and footwear	0.00	1.00	1.41
Wood and products of wood and cork	0.32	0.33	0.20
Pulp, paper, paper products, printing and publishing	0.20	1.15	1.35
Chemical, rubber, plastics and fuel products	0.20	0.79	1.59
Other non-metallic mineral products	2.12**	1.22	1.31
Basic metals and fabricated metal products	0.49	2.21**	0.00
Machinery and equipment	0.69	1.77*	1.71
Transport equipment	1.99*	1.27	0.91
Manufacturing nec.; Recycling	0.10	0.89	0.53
ELECTRICITY GAS AND, WATER SUPPLY	0.26	0.14	0.70
CONSTRUCTION	2.78**	2.02*	0.97
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	0.93	1.65	0.62
TRANSPORT, STORAGE AND COMMUNICATIONS	0.95	1.62	1.09
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	0.89	1.58	0.40
COMMUNITY, SOCIAL AND PERSONAL SERVICES	0.97	0.33	0.95
NON-AGRICULTURE BUSINESS SECTOR	1.89*	0.30	0.77
BUSINESS SECTOR SERVICES	0.66	2.00*	0.61
TOTAL SERVICES	1.10	2.15**	1.09
TOTAL	0.45	0.90[a]	0.00

Note: a. Since real GDP is not included in the regression for *Total economy*, the endogeneity test is carried out for the unemployment rate.

* The null hypothesis that the particular variable is exogenous is rejected at the 10 percent level of significance.

** The null hypothesis that the particular variable is exogenous is rejected at the 5 percent level of significance.

*** The null hypothesis that the particular variable is exogenous is rejected at the 1 percent level of significance.

Table 2.5 Estimation Results by Manufacturing Subsector, Value Added Volumes (baseline model)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: $\Delta valk_{it}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	0.067 (0.086)	0.205* (0.101)	0.120 (0.119)	0.080 (0.075)	0.131 (0.091)
$\Delta(e+p^f-p)_{t-1}$		0.259*** (0.073)			0.169** (0.071)
Δy_t	0.399** (0.146)	1.340*** (0.215)	1.579*** (0.236)	1.155*** (0.150)	1.228*** (0.206)
$\Delta(w-p)_t$	-0.232 (0.200)	-0.199 (0.148)	-0.328 (0.237)	-0.366** (0.136)	-0.200 (0.196)
Long-run coefficients					
$e+p^f-p$	0.659 (0.509)	2.472 (1.609)	0.999 (1.142)	0.833 (0.583)	0.081 (0.787)
y	0.335 (0.554)	-0.001 (1.726)	0.508 (1.389)	0.667 (0.595)	0.591 (0.779)
$w-p$	0.254 (0.491)	-2.080 (1.047)	0.367 (0.857)	-0.135 (0.493)	1.165 (0.973)
Adjustment coefficient (τ_i-1)	-0.083 (0.022)	-0.063 (0.029)	-0.070 (0.028)	-0.065 (0.015)	-0.082 (0.014)
PSS t-test $(k=3)$	-3.70^^	-2.15^	-2.48^	-4.28^^^	-5.76^^^
R^2	0.207	0.402	0.363	0.477	0.358
Number of countries	20	20	20	20	20
Number of observation	532	522	478	478	507
RESET test	0.01	26.34[c]	0.18	5.21[b]	0.09
AR(1) test	0.79	-1.17	-0.25	-1.22	-0.87

See notes to Table 2.2 (A).

Table 2.5 Estimation Results by Manufacturing Subsector, Value Added Volumes (baseline model) (continued)

Subsectors	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
Dependent variable: $\Delta valk_{it}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	0.006 (0.070)	0.302*** (0.082)	0.187 (0.115)	-0.159 (0.206)	0.235 (0.146)
$\Delta(e+p^f-p)_{t-1}$			0.285** (0.125)		
Δy_t	1.950*** (0.233)	1.559*** (0.202)	1.622*** (0.180)	1.815*** (0.461)	1.916*** (0.170)
$\Delta(w-p)_t$	-0.243 (0.145)	-0.051 (0.165)	0.056 (0.251)	0.062 (0.235)	-0.308 (0.241)
$\Delta valk_{i,t-1}$			0.164*** (0.042)		
Long-run coefficients					
$e+p^f-p$	0.233 (0.409)	1.500* (0.741)	2.388 (5.965)	-1.619 (2.368)	1.108 (0.764)
y	1.664*** (0.536)	0.734 (0.635)	2.261 (5.623)	0.955 (1.317)	2.279*** (0.638)
$w-p$	-0.406 (0.707)	-0.425 (0.653)	4.827 (6.875)	-0.503 (1.436)	-0.388 (0.573)
Adjustment coefficient $(\tau_i - 1)$	-0.092 (0.011)	-0.059 (0.014)	-0.014 (0.016)	-0.068 (0.011)	-0.113 (0.034)
PSS t-test $(k=3)$	-8.23^^^	-4.36^^^	-0.84^	-6.47^^^	-3.37^^
R^2	0.527	0.484	0.582	0.233	0.404
Number of countries	20	20	20	20	20
Number of observation	516	495	462	499	495
RESET test	1.42	3.50[a]	1.23	0.87	0.01
AR(1) test	-0.33	0.49	1.17	2.40[e]	1.63

See notes to Table 2.2 (A).

Table 2.6 Estimation Results by Manufacturing Subsector, Value Added Volumes (extended model with export orientation and import penetration)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: $\Delta \boldsymbol{valk_{it}}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	0.397** (0.161)	0.105 (0.245)	0.094 (0.211)	0.187* (0.101)	0.805** (0.278)
$\Delta(e+p^f-p)_{t-1}$		0.608*** (0.146)		-0.329** (0.140)	0.176** (0.070)
$x*\Delta(e+p^f-p)_t$	-0.204* (0.105)	0.028 (0.120)	0.126 (0.164)	-0.078 (0.073)	-0.220* (0.116)
$x*\Delta(e+p^f-p)_{t-1}$		-0.150** (0.071)		0.260** (0.109)	
$m*\Delta(e+p^f-p)_t$	-0.075*** (0.024)	0.023 (0.056)	-0.095* (0.050)	0.046*** (0.014)	-0.080 (0.091)
Δy_t	0.366** (0.143)	1.357*** (0.215)	1.623*** (0.237)	1.179*** (0.150)	1.236*** (0.206)
$\Delta(w-p)_t$	-0.210 (0.202)	-0.189 (0.153)	-0.291 (0.237)	-0.358** (0.134)	-0.225 (0.217)
$\Delta valk_{i,t-1}$					
Long-run coefficients					
$e+p^f-p$	0.438 (1.204)	2.194 (2.454)	2.593 (2.336)	3.047** (1.280)	10.319*** (2.710)
$x*(e+p^f-p)$	0.362 (0.653)	0.382 (0.885)	-0.659 (1.389)	-1.858* (0.923)	-2.717*** (0.843)
$m*(e+p^f-p)$	-0.201 (0.212)	-0.592 (0.531)	-0.330 (0.359)	0.214 (0.155)	-1.733** (0.785)
y	0.276 (0.537)	0.124 (1.602)	0.702 (1.292)	0.750 (0.595)	0.587 (0.621)
$w-p$	0.318 (0.485)	-2.228 (0.993)	0.102 (0.786)	0.078 (0.460)	1.588* (0.829)
Adjustment coefficient (τ_i-1)	-0.083 (0.022)	-0.064 (0.029)	-0.071 (0.026)	-0.073 (0.017)	-0.083 (0.016)
PSS t-test $(k=5)$	-3.78^^	-2.23^	-2.76^	-4.16^^^	-5.18^^^
R^2	0.218	0.407	0.368	0.486	0.374
Number of countries	20	20	20	20	20
Number of observation	532	522	478	470	507
RESET test	0.00	25.68[c]	0.28	4.68[b]	0.20
AR(1) test	0.63	-1.32	-0.61	-1.15	-1.25

See notes to Tables 2.2 (A) and 2.3.

Table 2.6 Estimation Results by Manufacturing Subsector, Value Added Volumes (extended model with export orientation and import penetration) (continued)

Subsectors	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
Dependent variable: $\Delta \boldsymbol{valk_{it}}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.155 (0.290)	0.230 (0.234)	-0.494 (1.151)	0.293 (0.854)	0.442** (0.190)
$\Delta(e+p^f-p)_{t-1}$	-0.606*** (0.182)		0.295** (0.113)		
$x*\Delta(e+p^f-p)_t$	-0.177 (0.348)	0.107 (0.182)	0.088 (0.246)	-0.250 (0.270)	-0.659 (0.439)
$x*\Delta(e+p^f-p)_{t-1}$	0.605** (0.250)				
$m*\Delta(e+p^f-p)_t$	0.067 (0.355)	-0.059 (0.035)	0.211 (0.326)	0.100* (0.053)	0.439 (0.349)
$m*\Delta(e+p^f-p)_{t-1}$		0.045* (0.022)			
Δy_t	2.038*** (0.240)	1.547*** (0.202)	1.561*** (0.200)	1.828*** (0.499)	1.923*** (0.175)
$\Delta(w-p)_t$	-0.313* (0.156)	-0.039 (0.169)	0.092 (0.237)	0.058 (0.227)	-0.292 (0.252)
$\Delta valk_{i,t-1}$			0.160*** (0.046)		
Long-run coefficients					
$e+p^f-p$	-0.406 (1.681)	2.448 (4.472)	-3.445 (23.398)	10.277 (8.418)	1.482 (1.389)
$x*(e+p^f-p)$	-2.956 (1.914)	-0.743 (2.694)	-12.459 (10.689)	-3.687 (2.708)	-0.890 (2.141)
$m*(e+p^f-p)$	3.949* (2.177)	-0.077 (0.196)	15.564 (13.271)	0.521 (0.533)	0.546 (1.554)
y	1.550*** (0.455)	0.920 (0.655)	2.090 (3.534)	0.847 (1.261)	2.242*** (0.671)
$w-p$	-0.683 (0.711)	-0.416 (0.769)	1.840 (2.855)	-1.347 (1.571)	-0.374 (0.549)
Adjustment coefficient (τ_i-1)	-0.102 (0.015)	-0.058 (0.015)	-0.022 (0.018)	-0.083 (0.015)	-0.115 (0.034)
PSS t-test $(k=5)$	-6.76^^^	-3.97^^	-1.25^	-5.57^^^	-3.35^^
R^2	0.534	0.476	0.592	0.246	0.408
Number of countries	20	20	20	20	20
Number of observation	507	487	462	499	495
RESET test	0.40	7.96[b]	0.25	1.71	0.02
AR(1) test	-0.40	0.34	1.01	2.45[e]	1.57

See notes to Tables 2.2 (A) and 2.3.

Table 2.7 Asymmetric Effects of the Exchange Rate, Value Added Volumes

Sectors	$\Delta(e+p^f-p)_t$	$D*\Delta(e+p^f-p)_t$	$e+p^f-p$	$D*(e+p^f-p)$	D	F statistic
AGRICULTURE, HUNTING, FORESTRY AND FISHING	0.080	0.004	0.958*	0.032	0.016	0.68
MINING AND QUARRYING	-0.608	-0.007	-0.115	-0.091	-0.045**	2.28
MANUFACTURING	0.144*	-0.002	2.508***	0.029	-0.009**	6.03***
ELECTRICITY GAS AND, WATER SUPPLY	0.097	-0.008	-1.344***	-0.055	-0.012	0.94
CONSTRUCTION	-0.123	0.002	-0.763**	0.001	0.010	1.63
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	-0.127	0.000	0.325	0.022	-0.005	0.93
TRANSPORT, STORAGE AND COMMUNICATIONS	-0.052	-0.001	-0.738	0.019	-0.008*	2.33
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	0.049	0.002**	0.225	0.030*	0.013**	2.18
COMMUNITY, SOCIAL AND PERSONAL SERVICES	-0.022	-0.001	-0.669	-0.032	-0.003	0.27
NON-AGRICULTURE BUSINESS SECTOR	0.024	0.002	0.630	0.037*	0.001	2.45
BUSINESS SECTOR SERVICES	-0.024	0.001	0.094	0.025	0.002	0.48
TOTAL SERVICES	-0.023	0.000	-0.135	0.017	0.001	0.40
TOTAL	0.047	-0.001	0.861	-0.011	-0.002	0.49
Manufacturing Subsectors						
Food products, beverages and tobacco	0.199	-0.005**	0.863	-0.055	-0.007	2.77*
Textiles, textile products, leather and footwear	0.161	0.001	2.405	0.070	-0.003	6.52***
Wood and products of wood and cork	0.219	-0.005	1.093	-0.055	-0.009	0.77
Pulp, paper, paper products, printing and publishing	0.025	-0.000	1.076	-0.021	-0.008	1.73
Chemical, rubber, plastics and fuel products	0.187	-0.000	0.633	0.018	-0.002	0.23
Other non-metallic mineral products	-0.018	0.001	0.422	-0.008	0.000	2.40
Basic metals and fabricated metal products	0.349**	-0.002	1.638**	-0.019	-0.003	0.27
Machinery and equipment	0.210	0.004	5.309	0.928	0.012	6.73***
Transport equipment	-0.384	0.003	-1.904	0.115	-0.003	1.34
Manufacturing nec.; Recycling	-0.036	-0.008	1.059	-0.051	-0.043***	5.15**

Note: Standard errors in parentheses. The estimated coefficients on $\Delta(e+p^f-p)_t$ contain coefficients on its lagged values, too. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on real value added.

* The F statistic is significant at the 10 percent significance level.

** The F statistic is significant at the 5 percent significance level.

*** The F statistic is significant at the 1 percent significance level

Table 2.8 Response to Exchange Rate Movements of EU and Non-EU Countries, Value Added Volumes

Sectors	Short run		Long run	
	$\Delta(e+p^f-p)_t$	$EU*\Delta(e+p^f-p)_t$	$e+p^f-p$	$EU*(e+p^f-p)$
AGRICULTURE, HUNTING, FORESTRY AND FISHING	-0.399*	0.578**	0.888	0.048
MINING AND QUARRYING	0.183	-0.672**	1.301	-2.047
MANUFACTURING	0.282**	0.093	2.295*	0.218
ELECTRICITY GAS AND, WATER SUPPLY	-0.063	-0.047	-0.639	-0.926
CONSTRUCTION	-0.694***	0.500***	-0.352	-0.433
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	0.097	-0.164	0.185	0.457
TRANSPORT, STORAGE AND COMMUNICATIONS	0.089	-0.068	-0.479	0.398
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	-0.041	0.027	0.969**	-1.070**
COMMUNITY, SOCIAL AND PERSONAL SERVICES	-0.009	-0.031	-0.486	-0.263
NON-AGRICULTURE BUSINESS SECTOR	0.145**	-0.065	0.317	0.881
BUSINESS SECTOR SERVICES	0.045	-0.061	0.481	-0.388
TOTAL SERVICES	0.020	-0.047	0.372	-0.559
TOTAL	0.029	0.033	1.056*	-0.213
Manufacturing Subsectors				
Food products, beverages and tobacco	0.017	0.088	2.307	-1.917
Textiles, textile products, leather and footwear	0.539**	-0.043	1.933	1.064
Wood and products of wood and cork	-0.046	0.217	3.852*	-3.592
Pulp, paper, paper products, printing and publishing	0.106	-0.017	1.964*	-1.282
Chemical, rubber, plastics and fuel products	0.352**	-0.161	2.276	-1.998
Other non-metallic mineral products	-0.002	-0.000	0.741	-0.657
Basic metals and fabricated metal products	0.279**	0.049	2.805*	-1.508
Machinery and equipment	0.325*	0.237	-3.925	11.910
Transport equipment	-0.345	0.284	-1.987	1.049
Manufacturing nec.; Recycling	0.546***	-0.415**	3.675***	-3.345***

Note: Note: *EU* = 1 if the country is a EU member (including Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, the UK), *EU* = 0 otherwise. The base includes six countries, namely, Australia, Canada, Japan, New Zealand, Norway, and the US. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on value added.

The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on real value added.

* The estimated coefficient is significant at the 10 percent significance level.
** The estimated coefficient is significant at the 5 percent significance level.
*** The estimated coefficient is significant at the 1 percent significance level.

Table 3.1 (A) Estimation Results by Sector, Real Wages (baseline model)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
Dependent variable: $\Delta(\boldsymbol{w_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	0.019 (0.117)	-0.063 (0.102)	0.031 (0.041)	-0.051 (0.091)	-0.133** (0.049)
$\Delta(e + p^f - p)_{t-1}$			-0.149*** (0.042)		
Δy_t	0.334* (0.182)	0.147 (0.320)	0.307*** (0.064)	0.104 (0.105)	0.530*** (0.090)
Δy_{t-1}					
$\Delta(w_i - p)_{t-1}$	0.152** (0.054)	-0.098** (0.036)			
Long-run coefficients					
$e + p^f - p$	0.135 (0.635)	-0.103 (0.356)	-0.185 (0.408)	-0.735 (0.714)	-0.979** (0.398)
y	-0.873 (0.767)	-0.486** (0.174)	-0.088 (0.167)	0.365 (0.369)	0.347 (0.229)
Adjustment coefficient $(\tau_i - 1)$	-0.059 (0.023)	-0.179 (0.045)	-0.056 (0.024)	-0.079 (0.026)	-0.088 (0.017)
PSS t-test $(k = 2)$	-2.64^	-3.95^^^	-2.35^	-3.07^^	-5.15^^^
R^2	0.225	0.192	0.271	0.162	0.253
Number of countries	20	18	20	20	20
Number of observations	610	537	642	618	628
RESET test	0.19	24.60[c]	1.04	0.27	0.04
AR(1) test	-0.41	-0.30	1.49	-2.07[e]	1.60

Note: Robust-clustered (by country) standard errors in parentheses.

The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on real wages and employment.

* The estimated coefficient is significant at the 10 percent significance level.

** The estimated coefficient is significant at the 5 percent significance level.

*** The estimated coefficient is significant at the 1 percent significance level.

The critical value bounds for the PSS t-test at the 5% level of significance are (-2.86, -3.53) for $k = 2$ and (-2.86, -3.99) for $k = 4$, the bounds at the 10% level are (-2.57, -3.21) and (-2.57, -3.66) for *k* = 2 and 4, respectively (Pesasan et al., (2001), pp.303, Table CII(iii)).

^ Indicates that the statistic lies below the 0.05 lower bound, so a long-run relationship does not exist at the 5% significance level.

^^ Indicates that the statistic falls within the 0.05 bounds, so a long-run relationship may or may not exist at the 5% significance level.

^^^ Indicates that the statistic lies above the 0.05 upper bound, so a long-run relationship exists at the 5% significance level.

a The null hypothesis of appropriate specification can be rejected at the 10 percent significance level, but not at the 5 or 1 percent significance level.

b The specification can be rejected at the 5 percent significance level, but not at the 1 percent significance level.

c The specification can be rejected at the 1 percent significance level.

d The null hypothesis of no first-order autocorrelation can be rejected a the 10 percent significance level, but not at the 5 or 1 percent significance level.

e The null hypothesis of no first-order autocorrelation can be rejected a the 5 percent significance level, but not at the 1 percent significance level.

f The null hypothesis of no first-order autocorrelation can be rejected a the 1 percent significance level.

Table 3.1 (A) Estimation Results by Sector, Real Wages (baseline model) (continued)

Sectors	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*
Dependent variable: $\Delta(\boldsymbol{w_i - p})_t$				
Short-run coefficients				
$\Delta(e + p^f - p)_t$	-0.089* (0.043)	-0.014 (0.033)	-0.127* (0.062)	-0.087** (0.037)
$\Delta(e + p^f - p)_{t-1}$	-0.081** (0.037)			-0.119*** (0.031)
Δy_t	0.269*** (0.093)	0.181** (0.071)	0.271** (0.095)	0.160* (0.086)
Δy_{t-1}		0.233** (0.089)		
$\Delta(w_i - p)_{t-1}$	0.141*** (0.047)		0.124*** (0.042)	0.206*** (0.056)
Long-run coefficients				
$e + p^f - p$	-0.184 (0.284)	-0.225 (0.242)	-0.873 (0.938)	-0.532* (0.298)
y	-0.112 (0.135)	-0.342*** (0.108)	0.613 (0.479)	0.167 (0.175)
Adjustment coefficient $(\tau_i - 1)$	-0.090 (0.020)	-0.121 (0.027)	-0.046 (0.016)	-0.090 (0.025)
PSS t-test $(k = 2)$	-4.42^^^	-4.39^^^	-2.82^	-3.66^^^
R^2	0.334	0.263	0.230	0.305
Number of countries	20	20	20	20
Number of observations	602	608	609	607
RESET test	2.64	3.49[a]	0.50	0.33
AR(1) test	-0.75	-1.90[d]	-0.21	-0.41

See notes to Table 3.1 (A)

Table 3.1 (B) Estimation Results by Multi-Sector Aggregate, Real Wages (baseline model)

Sectors	*Non-agriculture business sector*	*Business sector services*	*Total services*	*Total*
Dependent variable: $\Delta(\boldsymbol{w_i - p})_t$				
Short-run coefficients				
$\Delta(e + p^f - p)_t$	0.020 (0.039)	-0.081** (0.035)	-0.072* (0.039)	-0.061* (0.030)
$\Delta(e + p^f - p)_{t-1}$			-0.092** (0.033)	-0.096*** (0.024)
Δy_t	0.277*** (0.076)	0.209** (0.080)	0.176** (0.069)	0.293*** (0.061)
Δy_{t-1}		0.182** (0.074)	0.149* (0.078)	
$\Delta(w_i - p)_{t-1}$	0.220** (0.102)	0.114*** (0.033)	0.176*** (0.044)	0.183*** (0.040)
Long-run coefficients				
$e + p^f - p$	-0.851 (0.586)	-0.423 (0.380)	-0.474 (0.328)	-0.439* (0.225)
y	0.331 (0.231)	0.077 (0.178)	0.091 (0.168)	0.185 (0.161)
Adjustment coefficient $(\tau_i - 1)$	-0.055 (0.015)	-0.077 (0.018)	-0.070 (0.020)	-0.068 (0.018)
PSS t-test $(k = 2)$	-3.75^^^	-4.34^^^	-3.50^^	-3.70^^^
R^2	0.594	0.319	0.350	0.423
Number of countries	20	20	20	20
Number of observations	371	609	607	610
RESET test	1.31	0.04	0.14	4.05[a]
AR(1) test	-0.34	-0.26	-0.51	-0.61

See notes to Table 3.1 (A)

Table 3.2 (A) Estimation Results by Sector, Employment (baseline model)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
Dependent variable: Δl_{it}					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.039	-0.039	-0.058*	-0.101	-0.149***
	(0.073)	(0.071)	(0.033)	(0.092)	(0.049)
$\Delta(e+p^f-p)_{t-1}$			0.174***		-0.152**
			(0.024)		(0.068)
Δy_t	0.224	0.072	0.477***	-0.002	1.068***
	(0.136)	(0.252)	(0.096)	(0.130)	(0.131)
Δy_{t-1}			0.182**		0.381**
			(0.068)		(0.142)
$\Delta l_{i,t-1}$	0.193***	0.193**	0.339***		0.313***
	(0.062)	(0.070)	(0.063)		(0.068)
Long-run coefficients					
$e+p^f-p$	0.758	2.374	0.527	0.268	-0.639**
	(0.626)	(1.471)	(0.621)	(1.527)	(0.242)
y	-0.045	1.693*	0.282	0.661	1.551***
	(0.308)	(0.906)	(0.393)	(0.499)	(0.282)
Adjustment coefficient $(\tau_i - 1)$	-0.060	-0.038	-0.048	-0.037	-0.088
	(0.023)	(0.009)	(0.027)	(0.013)	(0.010)
PSS t-test $(k=2)$	-2.53^	-3.99^^^	-1.80^	-2.89^^	-9.02^^^
R^2	0.256	0.364	0.666	0.263	0.637
Number of countries	20	18	20	20	20
Number of observations	615	546	656	628	613
RESET test	3.76[a]	1.51	1.60	14.70[c]	0.62
AR(1) test	0.69	-0.14	-0.46	3.03[f]	-1.84[d]

See notes to Table 3.1 (A)

Table 3.2 (A) Estimation Results by Sector, Employment (baseline model) (continued)

Sectors	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*
Dependent variable: Δl_{it}				
Short-run coefficients				
$\Delta(e+p^f-p)_t$	-0.022 (0.025)	-0.019 (0.046)	-0.055 (0.044)	-0.034 (0.023)
Δy_t	0.471*** (0.054)	0.318*** (0.067)	0.431*** (0.071)	0.190*** (0.043)
Δy_{t-1}	0.201*** (0.065)	0.278*** (0.087)	0.310*** (0.079)	
$\Delta l_{i,t-1}$	0.320*** (0.058)	0.130** (0.049)	0.345*** (0.075)	0.187* (0.093)
Long-run coefficients				
$e+p^f-p$	-0.409 (0.331)	-0.334 (0.305)	-0.293 (0.296)	-0.285 (0.231)
y	0.609*** (0.173)	0.920 (0.187)	0.704 (0.256)	1.069*** (0.201)
Adjustment coefficient $(\tau_i - 1)$	-0.045 (0.009)	-0.081 (0.036)	-0.065 (0.025)	-0.068 (0.019)
PSS t-test $(k=2)$	-5.14^^^	-2.28^	-2.54^	-3.52^^
R^2	0.604	0.389	0.507	0.463
Number of countries	20	20	20	20
Number of observations	615	615	615	615
RESET test	2.94	2.50	1.29	0.27
AR(1) test	-0.36	-0.25	-0.34	0.36

See notes to Table 3.1 (A)

Table 3.2 (B) Estimation Results by Multi-Sector Aggregate, Employment (baseline model)

Sectors	*Non-agriculture business sector*	*Business sector services*	*Total services*	*Total*
Dependent variable: Δl_{it}				
Short-run coefficients				
$\Delta(e+p^f-p)_t$	-0.029 (0.027)	-0.029 (0.023)	-0.028* (0.014)	-0.037*** (0.012)
$\Delta(e+p^f-p)_{t-1}$				0.032** (0.013)
Δy_t	0.622*** (0.073)	0.441*** (0.046)	0.331*** (0.027)	0.415*** (0.038)
Δy_{t-1}	0.209** (0.092)	0.198*** (0.063)	0.116** (0.044)	0.112** (0.044)
$\Delta l_{i,t-1}$	0.357*** (0.065)	0.378*** (0.045)	0.351*** (0.062)	0.375*** (0.066)
Long-run coefficients				
$e+p^f-p$	-0.459 (0.364)	-0.383 (0.226)	-0.451* (0.259)	-0.243 (0.284)
y	0.349 (0.324)	0.580*** (0.186)	0.872*** (0.180)	0.669*** (0.209)
Adjustment coefficient $(\tau_i - 1)$	-0.049 (0.017)	-0.045 (0.011)	-0.035 (0.010)	-0.034 (0.007)
PSS t-test $(k=2)$	-2.86^^	-4.06^^^	-3.41^^	-4.57^^^
R^2	0.810	0.681	0.669	0.772
Number of countries	20	20	20	20
Number of observations	411	615	615	615
RESET test	0.72	0.00	1.30	0.35
AR(1) test	1.40	0.22	-0.14	0.29

See notes to Table 3.1 (A)

Table 3.3 Estimation Results by Sector, Real Wages
(extended model with export orientation and import penetration)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Total services*	*Total economy*
Dependent variable: $\Delta(\boldsymbol{w_i} - \boldsymbol{p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	0.207 (0.352)	-0.020 (0.135)	0.378 (0.246)	0.097 (0.095)	0.524 (0.410)
$\Delta(e + p^f - p)_{t-1}$			-0.679*** (0.185)	-0.235** (0.087)	-0.099*** (0.024)
$x * \Delta(e + p^f - p)_t$	0.108 (0.420)	0.007 (0.008)	-0.197 (0.133)	0.108** (0.042)	0.003 (0.002)
$x * \Delta(e + p^f - p)_{t-1}$			0.299*** (0.090)	-0.096** (0.045)	
$m * \Delta(e + p^f - p)_t$	-0.395 (0.728)	-0.067 (0.070)	0.015 (0.006)	-0.952** (0.375)	-1.053 (0.735)
$m * \Delta(e + p^f - p)_{t-1}$			-0.014* (0.007)	0.841* (0.402)	
Δy_t	0.402** (0.146)	0.109 (0.320)	0.311*** (0.068)	0.170** (0.070)	0.293*** (0.060)
Δy_{t-1}				0.164** (0.077)	
$\Delta(w_i - p)_{t-1}$	0.148** (0.053)	-0.099** (0.037)		0.160*** (0.046)	0.182*** (0.041)
Long-run coefficients					
$e + p^f - p$	-2.012 (2.088)	-0.606 (0.514)	-2.607 (1.879)	0.847 (0.766)	3.433 (3.564)
$x * (e + p^f - p)$	1.788 (2.494)	-0.026 (0.020)	0.844 (0.854)	0.970* (0.497)	0.019 (0.017)
$m * (e + p^f - p)$	1.900 (3.060)	0.452 (0.294)	0.444 (0.151)	-8.484* (4.396)	-6.904 (6.336)
y	-0.889 (0.935)	-0.429** (0.192)	-0.035 (0.160)	0.103 (0.202)	0.153 (0.177)
Adjustment coefficient $(\tau_i - 1)$	-0.058 (0.022)	-0.183 (0.046)	-0.061 (0.025)	-0.066 (0.019)	-0.067 (0.019)
PSS t-test $(k = 4)$	-2.61^	-3.98^^	-2.45^	-3.42^^	-3.51^^
R^2	0.234	0.196	0.300	0.360	0.425
Number of countries	20	18	20	20	20
Number of observations	610	537	642	607	610
RESET test	0.39	29.24[c]	0.00	0.18	3.01[a]
AR(1) test	-0.59	-0.36	1.14	-0.29	-0.60

See notes to Table 3.1 (A). In addition, x and m stand for the export share in sectoral value added, and import penetration of domestic markets, respectively. The F-test is used to test for the joint significance of the real exchange rates interacted with the three ratios.

Table 3.4 Estimation Results by Sector, Employment
(extended model with export orientation and import penetration)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Total Services*	*Total Economy*
Dependent variable: Δl_{it}					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.313 (0.202)	-0.098 (0.117)	-0.440*** (0.143)	-0.069 (0.051)	-0.042 (0.247)
$\Delta(e+p^f-p)_{t-1}$			0.431*** (0.122)		
$x*\Delta(e+p^f-p)_t$	0.036 (0.260)	0.005 (0.004)	0.203** (0.076)	-0.027 (0.028)	-0.000 (0.001)
$x*\Delta(e+p^f-p)_{t-1}$		0.019*** (0.003)	-0.138** (0.060)		
$m*\Delta(e+p^f-p)_t$	0.406 (0.438)	-0.027 (0.055)	-0.001 (0.006)	0.240 (0.247)	0.014 (0.440)
$m*\Delta(e+p^f-p)_{t-1}$					0.052*** (0.016)
Δy_t	0.217* (0.106)	-0.016 (0.271)	0.482*** (0.085)	0.334*** (0.027)	0.417*** (0.038)
Δy_{t-1}			0.172** (0.074)	0.116** (0.044)	0.112** (0.045)
$\Delta l_{i,t-1}$	0.177*** (0.045)	0.185** (0.071)	0.339*** (0.066)	0.347*** (0.065)	0.376*** (0.067)
Long-run coefficients					
$e+p^f-p$	0.132 (0.503)	2.338 (1.876)	2.778 (2.235)	-0.014 (0.531)	5.630 (4.366)
$x*(e+p^f-p)$	3.993*** (1.254)	-0.295*** (0.046)	-1.410 (1.143)	0.318 (0.376)	0.030 (0.021)
$m*(e+p^f-p)$	-2.451 (2.547)	0.365 (0.615)	0.273 (0.223)	-2.780 (3.358)	-10.499 (7.826)
y	-0.443* (0.253)	1.387* (0.766)	0.133 (0.542)	0.918*** (0.197)	0.660*** (0.214)
Adjustment coefficient (τ_i-1)	-0.065 (0.024)	-0.044 (0.010)	-0.048 (0.027)	-0.036 (0.011)	-0.035 (0.008)
PSS t-test $(k=4)$	-2.72^	-4.25^^^	-1.78^	-3.23^^	-4.54^^^
R^2	0.283	0.374	0.674	0.670	0.774
Number of countries	20	18	20	20	20
Number of observations	615	544	656	615	615
RESET test	5.77[b]	2.14	1.07	1.39	0.18
AR(1) test	0.64	-0.11	-0.78	-0.16	0.13

See notes to Tables 3.1 (A) and 3.3.

Table 3.5 Test for Endogeneity, Real Wages and Employment

Sectors	t-statistics			
	Real wages		Employment	
	Real Exchange rate	Real GDP	Real Exchange rate	Real GDP
AGRICULTURE, HUNTING, FORESTRY AND FISHING	1.35	0.97	0.69	0.57
MINING AND QUARRYING	1.60	0.41	0.48	0.60
MANUFACTURING	0.10	1.39	2.82**	1.17
Food products, beverages and tobacco	1.76*	0.98	0.50	1.36
Textiles, textile products, leather and footwear	0.71	1.75*	2.09*	0.24
Wood and products of wood and cork	1.63	1.12	1.91*	1.30
Pulp, paper, paper products, printing and publishing	0.10	0.95	0.26	1.64
Chemical, rubber, plastics and fuel products	2.03*	0.47	4.17***	1.00
Other non-metallic mineral products	0.39	0.37	0.45	1.57
Basic metals and fabricated metal products	1.96*	1.77*	1.79*	1.84*
Machinery and equipment	0.00	0.10	2.15**	0.17
Transport equipment	1.32	1.38	2.08*	1.11
Manufacturing nec.; Recycling	1.39	0.88	1.70	0.46
ELECTRICITY GAS AND, WATER SUPPLY	1.24	0.20	1.20	1.68
CONSTRUCTION	1.87*	2.05*	1.42	0.67
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	0.00	2.04*	1.26	0.55
TRANSPORT, STORAGE AND COMMUNICATIONS	1.36	1.24	0.70	1.01
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	0.61	0.73	1.28	2.17**
COMMUNITY, SOCIAL AND PERSONAL SERVICES	0.69	1.26	1.37	0.22
NON-AGRICULTURE BUSINESS SECTOR	2.11*	0.69	0.10	1.25
BUSINESS SECTOR SERVICES	1.49	1.86*	0.98	0.68
TOTAL SERVICES	0.17	0.62	0.26	1.86*
TOTAL	0.98	1.56	0.53	0.53

Note: * The null hypothesis that the particular variable is exogenous is rejected at the 10 percent level of significance.
** The null hypothesis that the particular variable is exogenous is rejected at the 5 percent level of significance.
*** The null hypothesis that the particular variable is exogenous is rejected at the 1 percent level of significance.

Table 3.6 Estimation Results by Sector, Real Wages (baseline model estimated using SUR)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
Dependent variable: $\Delta(\boldsymbol{w_i - p})_t$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	0.014 (0.078)	-0.063 (0.135)	0.018 (0.038)	-0.034 (0.078)	-0.127** (0.051)
$\Delta(e+p^f-p)_{t-1}$			-0.142*** (0.036)		
Δy_t	0.336** (0.132)	0.142 (0.236)	0.345*** (0.057)	0.095 (0.132)	0.489*** (0.087)
Δy_{t-1}			-0.135** (0.058)		
$\Delta(w_i-p)_{t-1}$	0.184*** (0.037)	-0.089** (0.045)	0.089** (0.039)		0.102*** (0.039)
Long-run coefficients					
$e+p^f-p$	0.096 (0.688)	-0.109 (0.432)	-0.071 (0.273)	-0.663 (0.526)	-1.005*** (0.301)
y	-0.862 (0.528)	-0.507* (0.316)	-0.19 (0.195)	0.412 (0.387)	0.258 (0.211)
Adjustment coefficient $(\tau_i - 1)$	-0.059 (0.011)	-0.168 (0.028)	-0.070 (0.014)	-0.078 (0.016)	-0.095 (0.016)
PSS t-test $(k=2)$	-5.39^^^	-5.94^^^	-4.95^^^	-4.88^^^	-6.02^^^
R^2	0.224	0.191	0.279	0.159	0.252
Number of countries	20	18	20	20	20
Number of observations	610	537	639	602	608
RESET test	0.08	67.13[c]	0.10	1.82	1.92
AR(1) test	-0.66	-0.34	-0.25	-1.08	-0.58
BP test of independence	153.42***	33.30***	51.08***	128.68***	25.678***

See notes to Table 3.1 (A).

Table 3.6 Estimation Results by Sector, Real Wages (baseline model estimated using SUR) (continued)

Sectors	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*
Dependent variable: $\Delta(\boldsymbol{w_i - p})_t$				
Short-run coefficients				
$\Delta(e + p^f - p)_t$	-0.075* (0.042)	0.016 (0.050)	-0.116** (0.048)	-0.089** (0.038)
$\Delta(e + p^f - p)_{t-1}$	-0.088** (0.039)	-0.109** (0.042)		-0.095** (0.038)
Δy_t	0.202*** (0.071)	0.199** (0.085)	0.277*** (0.081)	0.122* (0.065)
Δy_{t-1}	0.217*** (0.072)	0.238*** (0.085)		0.113* (0.063)
$\Delta(w_i - p)_{t-1}$	0.126*** (0.038)		0.146*** (0.037)	0.215*** (0.038)
Long-run coefficients				
$e + p^f - p$	-0.290 (0.233)	-0.094 (0.232)	-0.594 (0.408)	-0.631*** (0.225)
y	-0.200 (0.168)	-0.411** (0.177)	0.514* (0.291)	0.118 (0.158)
Adjustment coefficient $(\tau_i - 1)$	-0.094 (0.013)	-0.112 (0.014)	-0.064 (0.011)	-0.091 (0.014)
PSS t-test $(k = 2)$	-7.41^^^	-7.85^^^	-5.92^^^	-6.48^^^
R^2	0.335	0.269	0.226	0.309
Number of countries	20	20	20	20
Number of observations	602	604	609	607
RESET test	6.74[c]	4.97[b]	1.55	0.01
AR(1) test	-0.32	-0.78	-0.57	-0.46
BP test of independence	53.08***	149.01***	126.38***	58.246***

See notes to Table 3.1 (A).

Table 3.7 Estimation Results by Sector, Employment (baseline model estimated using SUR)

Sectors	***Agriculture, hunting, forestry and fishing***	***Mining and quarrying***	***Manufacturing***	***Electricity, gas and water supply***	***Construction***
Dependent variable: $\Delta \boldsymbol{l_{it}}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.048 (0.053)	-0.063 (0.107)	-0.048 (0.030)	-0.109* (0.062)	-0.130** (0.054)
$\Delta(e+p^f-p)_{t-1}$			0.164*** (0.029)		-0.168*** (0.052)
Δy_t	0.221** (0.090)	0.115 (0.189)	0.465*** (0.045)	-0.102 (0.109)	1.062*** (0.092)
Δy_{t-1}			0.195*** (0.050)	0.267*** (0.098)	0.383*** (0.104)
$\Delta l_{i,t-1}$	0.176*** (0.035)	0.184*** (0.042)	0.343*** (0.034)	0.149*** (0.038)	0.336*** (0.037)
Long-run coefficients					
$e+p^f-p$	0.804 (0.618)	1.965 (1.527)	0.550* (0.294)	-0.681 (1.012)	-0.567* (0.302)
y	-0.243 (0.482)	1.846* (1.075)	0.239 (0.213)	-0.186 (0.731)	1.526*** (0.216)
Adjustment coefficient $(\tau_i - 1)$	-0.045 (0.009)	-0.038 (0.009)	-0.055 (0.010)	-0.033 (0.010)	-0.095 (0.014)
PSS t-test $(k = 2)$	-5.18$^{\wedge\wedge\wedge}$	-4.23$^{\wedge\wedge\wedge}$	-5.61$^{\wedge\wedge\wedge}$	-3.26$^{\wedge\wedge}$	-6.62$^{\wedge\wedge\wedge}$
R^2	0.256	0.371	0.667	0.274	0.639
Number of countries	20	18	20	20	20
Number of observations	610	546	639	602	608
RESET test	26.96[c]	1.83	4.95[b]	8.34[c]	1.23
AR(1) test	0.52	-0.29	0.04	-0.78	-1.92[d]
BP test of independence	153.42***	33.30***	51.08***	128.68***	25.678***

See notes to Table 3.1 (A).

Table 3.7 Estimation Results by Sector, Employment (baseline model estimated using SUR) (continued)

Sectors	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*
Dependent variable: Δl_{it}				
Short-run coefficients				
$\Delta(e+p^f-p)_t$	-0.024 (0.024)	-0.009 (0.038)	-0.055 (0.038)	-0.033 (0.021)
Δy_t	0.463*** (0.041)	0.323*** (0.067)	0.415*** (0.067)	0.190*** (0.035)
Δy_{t-1}	0.191*** (0.047)	0.269*** (0.070)	0.314*** (0.065)	
$\Delta l_{i,t-1}$	0.321*** (0.035)	0.148*** (0.036)	0.356*** (0.034)	0.202*** (0.038)
Long-run coefficients				
$e+p^f-p$	-0.386 (0.261)	-0.230 (0.219)	-0.266 (0.287)	-0.265* (0.142)
y	0.620*** (0.196)	0.901*** (0.165)	0.659*** (0.212)	1.022*** (0.115)
Adjustment coefficient (τ_i-1)	-0.048 (0.009)	-0.093 (0.014)	-0.070 (0.012)	-0.077 (0.011)
PSS t-test $(k=2)$	-5.49^^^	-6.68^^^	-5.94^^^	-7.29^^^
R^2	0.624	0.391	0.510	0.459
Number of countries	20	20	20	20
Number of observations	602	604	609	607
RESET test	8.61[c]	38.85[c]	2.78[a]	0.73
AR(1) test	-0.29	-0.80	0.03	0.38
BP test of independence	53.08***	149.01***	126.38***	58.246***

See notes to Table 3.1 (A).

Table 3.8 Estimation Results by Manufacturing Subsector, Real Wages (baseline model)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: $\Delta(\boldsymbol{w_i} - \boldsymbol{p})_{\boldsymbol{t}}$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	-0.012 (0.054)	-0.009 (0.085)	-0.070 (0.068)	-0.032 (0.056)	0.123* (0.059)
$\Delta(e + p^f - p)_{t-1}$				-0.160*** (0.037)	-0.239*** (0.054)
Δy_t	0.181** (0.076)	0.205** (0.072)	0.415*** (0.105)	0.352*** (0.074)	0.217** (0.083)
$\Delta(w_i - p)_{t-1}$		-0.155** (0.060)			
Long-run coefficients					
$e + p^f - p$	-0.196 (0.409)	-0.612 (0.786)	-0.323 (0.435)	-0.006 (0.272)	0.350 (0.393)
y	-0.189 (0.229)	-0.042 (0.411)	0.139 (0.275)	0.151 (0.167)	0.091 (0.193)
Adjustment coefficient $(\tau_i - 1)$	-0.070 (0.023)	-0.065 (0.024)	-0.113 (0.022)	-0.115 (0.035)	-0.078 (0.039)
PSS t-test $(k = 2)$	-3.07^^	-2.75^	-5.15^^^	-3.25^^	-2.02^
R^2	0.252	0.192	0.221	0.227	0.189
Number of countries	20	20	20	20	20
Number of observations	627	608	601	611	605
RESET test	0.00	0.08	1.51	6.49[b]	1.26
AR(1) test	0.49	-0.14	0.21	-0.86	-1.72[d]

See notes to Table 3.1 (A).

Table 3.8 Estimation Results by Manufacturing Subsector, Real Wages (baseline model) (continued)

Subsectors	***Other non-metallic mineral products***	***Basic metals and fabricated metal products***	***Machinery and equipment***	***Transport equipment***	***Manufacturing nec.; Recycling***
Dependent variable: $\Delta(\boldsymbol{w_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	0.091 (0.070)	-0.000 (0.047)	0.040 (0.072)	-0.058 (0.077)	-0.181** (0.067)
$\Delta(e + p^f - p)_{t-1}$	-0.187*** (0.064)		-0.114* (0.057)		
Δy_t	0.264** (0.119)	0.239** (0.089)	0.197 (0.117)	0.169** (0.070)	0.228* (0.128)
$\Delta(w_i - p)_{t-1}$					
Long-run coefficients					
$e + p^f - p$	0.077 (0.393)	-0.123 (0.374)	0.102 (0.378)	-0.201 (0.292)	-0.609 (0.424)
y	0.164 (0.278)	-0.164 (0.232)	0.039 (0.164)	-0.607** (0.255)	0.362 (0.287)
Adjustment coefficient $(\tau_i - 1)$	-0.107 (0.022)	-0.093 (0.035)	-0.097 (0.045)	-0.141 (0.036)	-0.105 (0.037)
PSS t-test $(k = 2)$	-4.70^^^	-2.65^	-2.17^	-3.94^^^	-2.83^
R^2	0.200	0.224	0.170	0.195	0.194
Number of countries	20	20	20	20	20
Number of observations	595	620	604	616	601
RESET test	6.74[b]	0.29	0.57	1.26	0.03
AR(1) test	0.17	-0.28	-2.30[e]	-1.00	-1.96[d]

See notes to Table 3.1 (A).

Table 3.9 Estimation Results by Manufacturing Subsector, Employment (baseline model)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: $\Delta \boldsymbol{l}_{it}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.020 (0.043)	-0.057 (0.101)	-0.103 (0.072)	-0.030 (0.044)	-0.069 (0.052)
$\Delta(e+p^f-p)_{t-1}$		0.217*** (0.061)	0.144* (0.071)	0.088* (0.044)	0.179*** (0.052)
Δy_t	0.195** (0.080)	0.626*** (0.171)	0.858*** (0.206)	0.457*** (0.090)	0.357*** (0.067)
Δy_{t-1}	0.222*** (0.071)	0.331* (0.166)		0.384*** (0.085)	0.419*** (0.084)
$\Delta l_{i,t-1}$			0.096* (0.047)		
Long-run coefficients					
$e+p^f-p$	0.485 (0.759)	5.929 (4.581)	1.438 (1.271)	-0.946 (1.567)	-0.150 (0.865)
y	0.806 (0.632)	-3.199 (3.990)	1.140 (0.646)	-0.161 (0.932)	-0.354 (0.933)
Adjustment coefficient $(\tau_i - 1)$	-0.031 (0.021)	-0.027 (0.022)	-0.040 (0.012)	-0.024 (0.017)	-0.043 (0.023)
PSS t-test $(k=2)$	-1.51^	-1.24^	-3.32^^	-1.37^	-1.81^
R^2	0.246	0.448	0.374	0.399	0.376
Number of countries	20	20	20	20	20
Number of observations	635	633	613	632	626
RESET test	0.22	3.02[a]	2.23	0.02	0.18
AR(1) test	-0.55	4.62[f]	-0.59	0.09	0.85

See notes to Table 3.1 (A).

Table 3.9 Estimation Results by Manufacturing Subsector, Employment (baseline model) (continued)

Subsectors	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
Dependent variable: Δl_{it}					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.183*** (0.057)	-0.045 (0.043)	-0.103 (0.071)	-0.139* (0.079)	-0.092 (0.079)
$\Delta(e+p^f-p)_{t-1}$		0.159*** (0.044)	0.203*** (0.045)	0.233** (0.081)	0.165** (0.065)
Δy_t	0.658*** (0.147)	0.626*** (0.094)	0.717*** (0.136)	0.697*** (0.135)	0.463* (0.243)
Δy_{t-1}	0.384*** (0.112)	0.462*** (0.086)	0.366*** (0.047)	0.289* (0.164)	0.483*** (0.103)
$\Delta l_{i,t-1}$	0.150** (0.053)	0.143** (0.051)	0.165* (0.087)	0.176*** (0.036)	0.172*** (0.046)
Long-run coefficients					
$e+p^f-p$	0.361 (0.532)	0.362 (0.507)	0.012 (0.557)	-0.668 (1.089)	0.736 (0.709)
y	0.539 (0.441)	0.128 (0.352)	-0.303 (0.517)	0.461 (0.762)	0.619 (0.435)
Adjustment coefficient $(\tau_i - 1)$	-0.068 (0.020)	-0.058 (0.020)	-0.065 (0.017)	-0.064 (0.020)	-0.077 (0.024)
PSS t-test $(k=2)$	-3.32^^	-2.85^	-3.94^^^	-3.25^^	-3.18^^
R^2	0.430	0.507	0.525	0.325	0.392
Number of countries	20	20	20	20	20
Number of observations	613	622	622	628	613
RESET test	13.77[c]	7.08[b]	0.70	1.29	0.69
AR(1) test	-0.36	-0.89	-0.99	-0.46	-0.88

See notes to Table 3.1 (A).

Table 3.10 Estimation Results by Manufacturing Subsector, Real Wages (extended model with export orientation and import penetration)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: $\Delta(\boldsymbol{w_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	-0.027 (0.137)	0.264* (0.149)	-0.124 (0.151)	0.019 (0.111)	0.130 (0.204)
$\Delta(e + p^f - p)_{t-1}$				-0.267*** (0.053)	-0.240*** (0.057)
$x * \Delta(e + p^f - p)_t$	-0.008 (0.080)	-0.083 (0.070)	0.037 (0.088)	-0.058 (0.069)	0.058 (0.066)
$x * \Delta(e + p^f - p)_{t-1}$				0.132*** (0.030)	
$m * \Delta(e + p^f - p)_t$	0.034 (0.022)	-0.073* (0.041)	0.001 (0.004)	0.003 (0.005)	-0.055 (0.072)
$m * \Delta(e + p^f - p)_{t-1}$				0.015*** (0.005)	
Δy_t	0.178** (0.081)	0.220*** (0.075)	0.389*** (0.108)	0.322*** (0.082)	0.212** (0.085)
$\Delta(w_i - p)_{t-1}$		-0.157** (0.060)			
Long-run coefficients					
$e + p^f - p$	0.150 (0.830)	-0.713 (1.482)	-1.429** (0.629)	-0.520 (0.443)	-1.155 (1.327)
$x * (e + p^f - p)$	-0.401 (0.545)	0.611 (0.598)	0.801 (0.323)	0.373 (0.270)	0.359 (0.501)
$m * (e + p^f - p)$	0.131 (0.260)	-0.886** (0.388)	0.003 (0.049)	-0.071** (0.028)	0.305 (0.459)
y	-0.133 (0.234)	0.032 (0.369)	0.129 (0.272)	0.218 (0.173)	0.068 (0.194)
Adjustment coefficient $(\tau_i - 1)$	-0.070 (0.022)	-0.071 (0.021)	-0.120 (0.023)	-0.124 (0.037)	-0.081 (0.041)
PSS t-test $(k = 4)$	-3.13^^	-3.31^^	-5.30^^^	-3.33^^	-1.98^
R^2	0.256	0.207	0.229	0.242	0.193
Number of countries	20	20	20	20	20
Number of observations	627	608	601	611	605
RESET test	0.03	0.11	0.44	3.62[a]	2.76
AR(1) test	0.45	-0.20	0.17	-0.92	-1.91[d]

See notes to Table 3.3.

Table 3.10 Estimation Results by Manufacturing Subsector, Real Wages (extended model with export orientation and import penetration) (continued)

Subsectors	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
Dependent variable: $\Delta(\boldsymbol{w_i}-\boldsymbol{p})_{\boldsymbol{t}}$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	0.043 (0.214)	0.007 (0.144)	0.588*** (0.203)	-0.031 (0.224)	-0.324** (0.130)
$x*\Delta(e+p^f-p)_t$	0.389 (0.406)	-0.002 (0.090)	-0.250*** (0.083)	-0.017 (0.075)	0.271 (0.281)
$m*\Delta(e+p^f-p)_t$	-0.283 (0.292)	-0.002 (0.013)	-0.007 (0.009)	0.004 (0.014)	-0.142 (0.212)
$m*\Delta(e+p^f-p)_{t-1}$	-0.227** (0.081)				
Δy_t	0.314** (0.114)	0.250** (0.093)	0.209* (0.106)	0.187** (0.071)	0.223 (0.138)
$\Delta(w_i-p)_{t-1}$					
Long-run coefficients					
$e+p^f-p$	-3.111*** (1.003)	-1.639 (1.530)	0.850 (1.364)	-1.170 (1.074)	-1.789* (0.862)
$x*(e+p^f-p)$	1.999 (2.066)	0.829 (0.943)	-0.545 (0.492)	0.219 (0.341)	2.185 (1.562)
$m*(e+p^f-p)$	2.410 (1.641)	0.083 (0.064)	0.176 (0.115)	0.057 (0.055)	-1.121 (1.199)
y	0.202 (0.288)	-0.185 (0.244)	-0.024 (0.141)	-0.573** (0.251)	0.428 (0.320)
Adjustment coefficient (τ_i-1)	-0.120 (0.024)	-0.094 (0.035)	-0.100 (0.043)	-0.148 (0.039)	-0.115 (0.038)
PSS t-test $(k=4)$	-5.04^^^	-2.66^	-2.32^	-3.84^^	-2.99^^
R^2	0.221	0.228	0.192	0.202	0.208
Number of countries	20	20	20	20	20
Number of observations	595	620	619	616	601
RESET test	11.16[c]	0.21	3.78[a]	0.38	0.00
AR(1) test	0.05	-0.28	-2.42[e]	-0.99	-2.06[e]

See notes to Table 3.3.

Table 3.11 Estimation Results by Manufacturing Subsector, Employment (extended model with export orientation and import penetration)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: Δl_{it}					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.068 (0.156)	-0.254 (0.223)	-0.130 (0.113)	-0.011 (0.081)	0.011 (0.083)
$\Delta(e+p^f-p)_{t-1}$		0.251*** (0.062)			
$x*\Delta(e+p^f-p)_t$	0.036 (0.097)	0.094 (0.080)	0.025 (0.081)	0.015 (0.056)	-0.022 (0.046)
$x*\Delta(e+p^f-p)_{t-1}$			0.106*** (0.031)		
$m*\Delta(e+p^f-p)_t$	-0.003 (0.032)	-0.022 (0.033)	0.011 (0.018)	0.010 (0.006)	-0.020 (0.037)
$m*\Delta(e+p^f-p)_{t-1}$				-0.019*** (0.004)	0.080*** (0.020)
Δy_t	0.189** (0.083)	0.630*** (0.190)	0.879*** (0.217)	0.462*** (0.092)	0.352*** (0.061)
Δy_{t-1}	0.230*** (0.069)			0.415*** (0.091)	0.418*** (0.096)
$\Delta l_{i,t-1}$		0.227** (0.102)			
Long-run coefficients					
$e+p^f-p$	-1.772 (1.138)	5.830 (4.047)	3.841* (2.078)	-0.411 (1.349)	0.716 (3.148)
$x*(e+p^f-p)$	1.753** (0.821)	-0.739 (1.130)	-0.912* (0.509)	0.349 (1.330)	-1.062 (1.085)
$m*(e+p^f-p)$	-0.127 (0.183)	-0.422 (0.867)	-0.490 (0.321)	0.426 (0.248)	0.485 (0.828)
y	0.467 (0.332)	-2.064 (2.183)	1.519* (0.742)	-0.147 (0.723)	-0.349 (0.862)
Adjustment coefficient $(\tau_i - 1)$	-0.048 (0.022)	-0.032 (0.018)	-0.039 (0.012)	-0.032 (0.020)	-0.045 (0.023)
PSS t-test $(k=4)$	-2.16^	-1.80^	-3.16^^	-1.60^	-1.99^
R^2	0.259	0.473	0.380	0.405	0.385
Number of countries	20	20	20	20	20
Number of observations	635	630	617	632	626
RESET test	1.20	12.19[c]	2.30	0.03	0.06
AR(1) test	-0.66	-2.44[e]	1.44	-0.22	0.76

See notes to Table 3.3.

Table 3.11 Estimation Results by Manufacturing Subsector, Employment (extended model with export orientation and import penetration) (continued)

Subsectors	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
Dependent variable: Δl_{it}					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.124 (0.183)	-0.023 (0.081)	-0.792* (0.421)	-0.649*** (0.134)	-0.053 (0.179)
$\Delta(e+p^f-p)_{t-1}$		0.157*** (0.044)	0.194*** (0.047)	0.219** (0.081)	
$x*\Delta(e+p^f-p)_t$	-0.441 (0.259)	-0.027 (0.077)	0.278 (0.161)	0.213*** (0.049)	-0.283 (0.275)
$m*\Delta(e+p^f-p)_t$	0.301 (0.297)	0.008 (0.012)	-0.006 (0.015)	-0.029* (0.015)	0.222 (0.173)
$m*\Delta(e+p^f-p)_{t-1}$					0.059* (0.032)
Δy_t	0.660*** (0.146)	0.626*** (0.094)	0.709*** (0.123)	0.794*** (0.130)	0.488** (0.218)
Δy_{t-1}	0.379*** (0.111)	0.465*** (0.087)	0.450*** (0.106)		0.547*** (0.112)
$\Delta l_{i,t-1}$	0.153** (0.053)	0.141** (0.052)		0.195*** (0.039)	0.152** (0.054)
Long-run coefficients					
$e+p^f-p$	0.747 (1.425)	-1.384 (1.650)	2.858 (2.992)	0.405 (2.363)	2.532** (1.017)
$x*(e+p^f-p)$	-4.051 (2.559)	1.124 (1.307)	-1.141 (1.097)	-0.348 (0.692)	-5.590*** (1.761)
$m*(e+p^f-p)$	3.000 (2.652)	0.008 (0.177)	0.105 (0.148)	0.089 (0.157)	3.719*** (1.268)
y	0.489 (0.383)	0.049 (0.348)	-0.751 (0.750)	0.670 (0.758)	0.285 (0.366)
Adjustment coefficient (τ_i-1)	-0.072 (0.020)	-0.057 (0.020)	-0.058 (0.017)	-0.064 (0.019)	-0.102 (0.029)
PSS t-test $(k=4)$	-3.54^^	-2.80^	-3.43^^	-3.29^^	-3.50^^
R^2	0.435	0.509	0.531	0.334	0.424
Number of countries	20	20	20	20	20
Number of observations	613	622	626	628	613
RESET test	14.64[c]	7.02[b]	0.15	0.16	0.13
AR(1) test	-0.50	-0.91	2.82[f]	-1.28	-0.84

See notes to Table 3.3.

Table 3.12 (A) Asymmetric Effects of the Exchange Rate, Real Wages

Sectors	$\Delta(e+p^f-p)_t$	$D*\Delta(e+p^f-p)_t$	$e+p^f-p$	$D*(e+p^f-p)$	D	F statistic
AGRICULTURE, HUNTING, FORESTRY AND FISHING	0.065	-0.005	0.367	-0.105	-0.014	0.86
MINING AND QUARRYING	-0.094	0.002	-0.096	0.011	0.005	0.13
MANUFACTURING	-0.224**	-0.001	-0.244	0.008	-0.006	1.41
ELECTRICITY GAS AND, WATER SUPPLY	-0.116	0.002	-0.891	0.048	0.005	0.75
CONSTRUCTION	-0.106	-0.001	-0.948**	-0.013	-0.001	0.43
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	-0.218***	-0.001	-0.197	-0.000	-0.004	0.46
TRANSPORT, STORAGE AND COMMUNICATIONS	-0.065	0.003	-0.178	0.013	0.004	1.73
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	-0.110**	-0.000	-0.928	0.007	0.001	0.20
COMMUNITY, SOCIAL AND PERSONAL SERVICES	-0.270***	0.001	-0.568*	0.013	-0.001	0.36
NON-AGRICULTURE BUSINESS SECTOR	-0.050	0.001	-0.812	0.004	-0.000	0.65
BUSINESS SECTOR SERVICES	-0.087***	-0.000	-0.414	-0.004	-0.001	0.06
TOTAL SERVICES	-0.231***	0.000	-0.522	0.013	-0.002	0.63
TOTAL	-0.213***	0.000	-0.459*	0.014	-0.002	0.84
Manufacturing Subsectors						
Food products, beverages and tobacco	-0.056	-0.000	-0.158	-0.014	-0.005	0.97
Textiles, textile products, leather and footwear	-0.109	-0.000	-0.649	-0.004	-0.009	0.96
Wood and products of wood and cork	-0.127	-0.001	-0.332	-0.012	-0.008	0.70
Pulp, paper, paper products, printing and publishing	-0.405***	-0.003	-0.074	0.010	-0.011	2.15
Chemical, rubber, plastics and fuel products	-0.205***	0.001	0.284	0.010	-0.004	1.49
Other non-metallic mineral products	-0.352**	0.004	-0.052	0.058*	0.000	3.03*
Basic metals and fabricated metal products	-0.166**	-0.000	-0.219	0.000	-0.013**	5.48***
Machinery and equipment	-0.172*	-0.004**	0.074	-0.016	-0.012**	2.68*
Transport equipment	-0.050	-0.001	-0.187	-0.006	-0.002	0.06
Manufacturing nec.; Recycling	-0.294**	-0.003	-0.621	-0.028	-0.017	1.82

Note: Standard errors in parentheses. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on real wages. The estimated coefficients on $\Delta(e+p^f-p)_t$ contain coefficients on its lagged values, too.

* The F statistic is significant at the 10 percent significance level.

** The F statistic is significant at the 5 percent significance level.

*** The F statistic is significant at the 1 percent significance level.

Table 3.12 (B) Asymmetric Effects of the Exchange Rate, Employment

Sectors	$\Delta(e+p^f-p)_t$	$D*\Delta(e+p^f-p)_t$	$e+p^f-p$	$D*(e+p^f-p)$	D	F statistic
AGRICULTURE, HUNTING, FORESTRY AND FISHING	-0.106	-0.000	0.537	0.019	-0.005	0.92
MINING AND QUARRYING	-0.175	0.007***	1.787	0.216***	0.015	3.55**
MANUFACTURING	0.019***	0.002*	0.451	0.063	0.002	1.67
ELECTRICITY GAS AND, WATER SUPPLY	-0.330*	0.003	-0.185	0.168*	0.008	1.55
CONSTRUCTION	-0.397***	0.004*	-0.710**	0.048	0.006	1.17
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	-0.018	0.001	-0.284	0.008	0.003	1.63
TRANSPORT, STORAGE AND COMMUNICATIONS	-0.042	0.000	-0.421	0.015	0.000	1.06
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	-0.104***	0.003	-0.265	0.036	0.005	0.74
COMMUNITY, SOCIAL AND PERSONAL SERVICES	-0.029	-0.001	-0.270	-0.017	-0.003	1.02
NON-AGRICULTURE BUSINESS SECTOR	-0.097***	0.002*	-0.608	0.050**	0.002	2.20
BUSINESS SECTOR SERVICES	-0.045	0.001	-0.339	0.020	0.003	1.16
TOTAL SERVICES	-0.036*	0.000	-0.418*	0.002	0.000	0.91
TOTAL	-0.063***	0.001**	-0.250	0.038**	0.001	4.22**
Manufacturing Subsectors						
Food products, beverages and tobacco	-0.035	0.002	0.318	0.077	0.005	2.19
Textiles, textile products, leather and footwear	-0.216	0.002	6.048	0.281	-0.004	7.19***
Wood and products of wood and cork	-0.140	0.004*	1.508	0.138*	0.008	1.67
Pulp, paper, paper products, printing and publishing	0.058**	0.005***	-0.899	0.150	0.013	7.74***
Chemical, rubber, plastics and fuel products	0.008**	0.003	-0.282	0.084	0.003	0.68
Other non-metallic mineral products	-0.264**	0.003	0.212	0.054	0.003	1.07
Basic metals and fabricated metal products	0.035**	0.002	0.295	0.046	0.003	1.24
Machinery and equipment	0.008**	0.005**	-0.060	0.087*	0.012*	1.95
Transport equipment	-0.224**	0.000	-0.868	0.077	-0.005	4.70**
Manufacturing nec.; Recycling	-0.009**	0.001	0.676	-0.001	-0.007	3.12*

Note: Standard errors in parentheses. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on employment. The estimated coefficients on $\Delta(e+p^f-p)_t$ contain coefficients on its lagged values, too.

* The F statistic is significant at the 10 percent significance level.

** The F statistic is significant at the 5 percent significance level.

*** The F statistic is significant at the 1 percent significance level.

Table 3.13 (A) Response to Exchange Rate Movements of EU and Non-EU Countries, Real wages

Sectors	Short run		Long run	
	$\Delta(e+p^f-p)_t$	$EU*\Delta(e+p^f-p)_t$	$e+p^f-p$	$EU*(e+p^f-p)$
AGRICULTURE, HUNTING, FORESTRY AND FISHING	0.441	-0.560	0.098	0.167
MINING AND QUARRYING	-0.300	0.323	0.073	-0.269
MANUFACTURING	-0.079***	0.044	-0.676	0.717
ELECTRICITY GAS AND, WATER SUPPLY	-0.012	-0.053	-0.760*	0.042
CONSTRUCTION	-0.071	-0.079	-1.736***	1.189*
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	-0.151*	-0.028	0.191	-0.531
TRANSPORT, STORAGE AND COMMUNICATIONS	-0.119**	0.140*	-0.355	0.175
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	-0.150**	0.030	0.069	-1.385
COMMUNITY, SOCIAL AND PERSONAL SERVICES	-0.238***	0.044	-0.682	0.208
NON-AGRICULTURE BUSINESS SECTOR	-0.072	0.072	-1.269	0.575
BUSINESS SECTOR SERVICES	-0.124***	0.056	-0.047	-0.566
TOTAL SERVICES	-0.189***	0.033	-0.290	-0.280
TOTAL	-0.165***	0.011	-0.563	0.176
Manufacturing Subsectors				
Food products, beverages and tobacco	0.119	-0.175	0.236	-0.607
Textiles, textile products, leather and footwear	-0.062	0.075	-2.747	3.112
Wood and products of wood and cork	-0.141*	0.098	-0.870	0.813
Pulp, paper, paper products, printing and publishing	-0.148***	-0.061	-0.210	0.302
Chemical, rubber, plastics and fuel products	-0.204***	0.119	-0.233	0.809
Other non-metallic mineral products	-0.195**	0.134	-1.052**	1.556**
Basic metals and fabricated metal products	0.012	-0.016	-0.046	-0.111
Machinery and equipment	0.075*	-0.204	-0.360	0.691
Transport equipment	0.056	-0.153	0.020	-0.314
Manufacturing nec.; Recycling	-0.104	-0.101	-1.597	1.519

Note: Note: *EU* = 1 if the country is a EU member (including Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, the UK), *EU* = 0 otherwise; *JP* = 1 if the country is Japan, *JP* = 0 otherwise. The base includes five countries, namely, Australia, Canada, New Zealand, Norway, and the US. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on wages.

* The estimated coefficient is significant at the 10 percent significance level.

** The estimated coefficient is significant at the 5 percent significance level.

*** The estimated coefficient is significant at the 1 percent significance level.

Table 3.13 (B) Response to Exchange Rate Movements of EU and Non-EU Countries, Employment

Sectors	Short run		Long run	
	$\Delta(e+p^f-p)_t$	$EU*\Delta(e+p^f-p)_t$	$e+p^f-p$	$EU*(e+p^f-p)$
AGRICULTURE, HUNTING, FORESTRY AND FISHING	-0.099	0.079	2.457	-2.478
MINING AND QUARRYING	-0.149	0.149	3.981*	-2.481
MANUFACTURING	0.127***	-0.019	1.368	-1.163
ELECTRICITY GAS AND, WATER SUPPLY	-0.328	0.303	-2.635	4.050
CONSTRUCTION	-0.494***	0.263***	-0.708	0.068
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	0.029	-0.070	0.184	-0.791
TRANSPORT, STORAGE AND COMMUNICATIONS	-0.080	0.082	-0.448	0.148
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	-0.063	0.011	-0.065	-0.317
COMMUNITY, SOCIAL AND PERSONAL SERVICES	0.010	-0.059*	-0.373*	0.125
NON-AGRICULTURE BUSINESS SECTOR	-0.058	0.043	-0.126	-0.521
BUSINESS SECTOR SERVICES	-0.014	-0.021	-0.002	-0.504
TOTAL SERVICES	-0.008	-0.027	-0.313	-0.174
TOTAL	0.000**	-0.007	0.287	-0.513
Manufacturing Subsectors				
Food products, beverages and tobacco	-0.054	0.045	0.461	0.027
Textiles, textile products, leather and footwear	0.409***	-0.317**	6.687	-4.104
Wood and products of wood and cork	0.145	-0.142	2.720**	-1.909
Pulp, paper, paper products, printing and publishing	0.012	0.063	1.340	-3.134
Chemical, rubber, plastics and fuel products	0.117***	-0.004	1.648	-2.525
Other non-metallic mineral products	-0.083	-0.140	1.790**	-2.085**
Basic metals and fabricated metal products	0.120***	-0.008	0.816	-0.644
Machinery and equipment	-0.139***	0.293	1.640	-1.929
Transport equipment	0.075**	0.027	-0.499	-0.247
Manufacturing nec.; Recycling	0.416**	-0.506***	3.645***	-4.310***

Note: Note: *EU* = 1 if the country is a EU member (including Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, the UK), *EU* = 0 otherwise; *JP* = 1 if the country is Japan, *JP* = 0 otherwise. The base includes five countries, namely, Australia, Canada, New Zealand, Norway, and the US. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on employment.

* The estimated coefficient is significant at the 10 percent significance level.
** The estimated coefficient is significant at the 5 percent significance level.
*** The estimated coefficient is significant at the 1 percent significance level.

Table 3.14 Adjusted Exchange Rate Coefficients (Baseline Models)

(A) Sectors that comprise the total economy

Dependent variable	Exchange rate parameter	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
$\Delta(\boldsymbol{\pi_i - p})_t$	$\Delta(e + p^f - p)_t$	0.669***	0.128	0.541***	-0.319	-0.191
	$e + p^f - p$	0.418*	0.610	1.498***	-0.603	-0.886***
$\Delta(\boldsymbol{va_i - p})_t$	$\Delta(e + p^f - p)_t$	0.025	-0.191	0.222***	-0.060	-0.193**
	$e + p^f - p$	0.597**	-0.070	1.567**	-0.855***	-0.619***
$\Delta(\boldsymbol{w_i - p})_t$	$\Delta(e + p^f - p)_t$	0.012	-0.040	-0.074**	-0.032	-0.084**
	$e + p^f - p$	0.085	-0.065	-0.081	-0.465	-0.620**
$\Delta \boldsymbol{emp_{it}}$	$\Delta(e + p^f - p)_t$	-0.025	-0.025	0.073***	-0.064	-0.191***
	$e + p^f - p$	0.480	1.503	0.334	0.170	-0.404**
$\Delta(\boldsymbol{w_i - p})_t$ (estimate using SUR)	$\Delta(e + p^f - p)_t$	0.009	-0.040	-0.078***	-0.022	-0.080**
	$e + p^f - p$	0.061	-0.069	-0.045	-0.420	-0.636***
$\Delta \boldsymbol{emp_{it}}$ (estimate using SUR)	$\Delta(e + p^f - p)_t$	-0.030	-0.040	0.073***	-0.069*	-0.189***
	$e + p^f - p$	0.509	1.244	0.348*	-0.431	-0.359*

Note: To obtain the effects of the real exchange rate itself on the dependent variables, the original real exchange rate coefficients are multiplied by the average trade share 0.633.

(A) Sectors that comprise the total economy (continued)

Dependent variable	Exchange rate parameter	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*
$\Delta(\boldsymbol{\pi_i - p})_t$	$\Delta(e + p^f - p)_t$	0.129	0.049	0.075*	0.030
	$e + p^f - p$	0.679*	0.013	-0.274	0.070
$\Delta(\boldsymbol{va_i - p})_t$	$\Delta(e + p^f - p)_t$	-0.014	0.025	-0.012	-0.020
	$e + p^f - p$	0.332	-0.125	0.106	-0.435*
$\Delta(\boldsymbol{w_i - p})_t$	$\Delta(e + p^f - p)_t$	-0.108***	-0.009	-0.080*	-0.130***
	$e + p^f - p$	-0.116	-0.142	-0.553	-0.337*
$\Delta \boldsymbol{emp_{it}}$	$\Delta(e + p^f - p)_t$	-0.014	-0.012	-0.035	-0.022
	$e + p^f - p$	-0.259	-0.211	-0.185	-0.180
$\Delta(\boldsymbol{w_i - p})_t$ (estimate using SUR)	$\Delta(e + p^f - p)_t$	-0.103***	-0.059*	-0.073**	-0.116***
	$e + p^f - p$	-0.184	-0.060	-0.376	-0.399***
$\Delta \boldsymbol{emp_{it}}$ (estimate using SUR)	$\Delta(e + p^f - p)_t$	-0.015	-0.006	-0.035	-0.021
	$e + p^f - p$	-0.244	-0.146	-0.168	-0.168*

See note to Table 3.14 (A).

(B) Multi-sector aggregates

Dependent variable	Exchange rate parameter	*Non-agriculture business sector*	*Business sector services*	*Total services*	*Total*
$\Delta(\boldsymbol{\pi_i - p})_t$	$\Delta(e + p^f - p)_t$	0.051	0.082**	0.065**	0.093***
	$e + p^f - p$	0.009	0.364	0.222	0.305**
$\Delta(\boldsymbol{va_i - p})_t$	$\Delta(e + p^f - p)_t$	0.063**	-0.001	-0.009	0.034*
	$e + p^f - p$	0.518*	-0.189	-0.037	0.578
$\Delta(\boldsymbol{w_i - p})_t$	$\Delta(e + p^f - p)_t$	0.013	-0.051**	-0.104***	-0.100***
	$e + p^f - p$	-0.539	-0.268	-0.300	-0.278*
$\Delta \boldsymbol{emp_{it}}$	$\Delta(e + p^f - p)_t$	-0.018	-0.018	-0.018*	-0.003
	$e + p^f - p$	-0.291	-0.242	-0.285*	-0.154

See note to Table 3.14 (A).

(C) Manufacturing Subsectors

Dependent variable	Exchange rate parameter	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
$\Delta(\boldsymbol{\pi_i} - \boldsymbol{p})_t$	$\Delta(e + p^f - p)_t$	-0.170	0.482**	0.882**	0.602**	0.659***
	$e + p^f - p$	0.478	2.256**	0.719	0.429	1.404**
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$	$\Delta(e + p^f - p)_t$	0.042	0.294***	0.076	0.051	0.190***
	$e + p^f - p$	0.417	1.565	0.632	0.527	0.051
$\Delta(\boldsymbol{w_i} - \boldsymbol{p})_t$	$\Delta(e + p^f - p)_t$	-0.008	-0.006	-0.044	-0.122***	-0.074*
	$e + p^f - p$	-0.124	-0.387	-0.204	-0.004	0.222
$\Delta\boldsymbol{emp_{it}}$	$\Delta(e + p^f - p)_t$	-0.013	0.101	0.026	0.037	0.070**
	$e + p^f - p$	0.307	3.753	0.910	-0.599	-0.095

See note to Table 3.14 (A).

(C) Manufacturing Subsectors (continued)

Dependent variable	Exchange rate parameter	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
$\Delta(\boldsymbol{\pi_i} - \boldsymbol{p})_t$	$\Delta(e + p^f - p)_t$	0.013	1.057***	0.235	1.222	-0.078
	$e + p^f - p$	0.217	1.666***	0.855	0.999	0.134
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$	$\Delta(e + p^f - p)_t$	0.004	0.191***	0.299***	-0.101	0.149
	$e + p^f - p$	0.147	0.950*	1.512	-1.025	0.701
$\Delta(\boldsymbol{w_i} - \boldsymbol{p})_t$	$\Delta(e + p^f - p)_t$	-0.060	-0.000	-0.047	-0.037	-0.115**
	$e + p^f - p$	0.049	-0.078	0.065	-0.127	-0.385
$\Delta\boldsymbol{emp_{it}}$	$\Delta(e + p^f - p)_t$	-0.116***	0.072**	0.063	0.060	0.046
	$e + p^f - p$	0.229	0.229	0.008	-0.423	0.466

Table 3.15 Adjusted Exchange Rate Coefficients (extended models)

(A) Average Export Orientation and Import Penetration

Sectors and Multi-Sector Aggregates	Average Export Share in Value Added (x)	Average Import penetration (m)
AGRICULTURE, HUNTING, FORESTRY AND FISHING	0.358	0.380
MINING AND QUARRYING	2.141	0.649
MANUFACTURING	1.193	0.960
TOTAL SERVICES	1.037	0.218
TOTAL ECONOMY	6.291	0.371
Manufacturing subsectors		
Food products, beverages and tobacco	0.899	0.374
Textiles, textile products, leather and footwear	1.432	0.907
Wood and products of wood and cork	0.759	0.779
Pulp, paper, paper products, printing and publishing	0.589	0.021
Chemical, rubber, plastics and fuel products	1.415	1.634*
Other non-metallic mineral products	0.410	0.450
Basic metals and fabricated metal products	0.956	1.421
Machinery and equipment	1.508	0.859
Transport equipment	1.887	2.524
Manufacturing nec.; Recycling	0.827	0.968

Note: Export orientation is calculated as the share of sectoral exports in sectoral value added, and import penetration as sectoral imports/(sectoral value added + sectoral imports – sectoral exports). Both shares are then averaged across all sample countries over the period 1971-2008. The import penetration rate for *Chemical, rubber, plastics and fuel products* is calculated as sectoral imports/sectoral value added, since the rate will be negative if it is defined otherwise.

(B) Sectors that comprise the total economy

Dependent variable	Exchange rate parameter	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Total Services*	*Total Economy*
$\Delta(\boldsymbol{\pi_i - p})_t$ (with x and m)	$\Delta(e + p^f - p)_t$	0.611***	0.257	0.537***	0.051	0.094***
	$e + p^f - p$	0.501**	-0.227	1.540***	0.337*	0.295**
$\Delta(\boldsymbol{va_i - p})_t$ (with *x* and *m*)	$\Delta(e + p^f - p)_t$	-0.005	-0.246**	0.191***	-0.013	0.038**
	$e + p^f - p$	0.547**	-0.571	1.954***	-0.172	0.575
$\Delta(\boldsymbol{w_i - p})_t$ (with x and m)	$\Delta(e + p^f - p)_t$	0.019	-0.041	-0.070**	-0.099***	-0.102***
	$e + p^f - p$	0.086	-0.147	-0.216	-0.308	-0.266
$\Delta\boldsymbol{emp_{it}}$ (with x and m)	$\Delta(e + p^f - p)_t$	-0.031	-0.028	0.070***	-0.020*	-0.003
	$e + p^f - p$	0.582*	1.086	0.338	-0.285*	-0.144

See note to Table 3.15 (A).

(C) Manufacturing subsectors

Dependent variable	Exchange rate parameter	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
$\Delta(\boldsymbol{\pi_i - p})_t$ (with x and m)	$\Delta(e + p^f - p)_t$	-0.161	0.497*	0.994***	0.515***	0.721***
	$e + p^f - p$	0.501	2.170**	0.572	0.181	1.088**
$\Delta(\boldsymbol{va_i - p})_t$ (with *x* and *m*)	$\Delta(e + p^f - p)_t$	0.040	0.297***	0.082	0.018	0.178***
	$e + p^f - p$	0.527*	1.399	0.884	0.839**	-0.144
$\Delta(\boldsymbol{w_i - p})_t$ (with *x* and *m*)	$\Delta(e + p^f - p)_t$	-0.012	-0.019	-0.050	-0.113***	-0.077*
	$e + p^f - p$	-0.217	-0.380	-0.294	-0.111	0.276
$\Delta \boldsymbol{emp_{it}}$ (with *x* and *m*)	$\Delta(e + p^f - p)_t$	-0.012	0.112**	0.026	0.002	0.075**
	$e + p^f - p$	0.407	2.250	1.358	-0.045	-0.256

See note to Table 3.15 (A).

(C) Manufacturing subsectors (continued)

Dependent variable	Exchange rate parameter	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
$\Delta(\boldsymbol{\pi_i - p})_t$ (with x and m)	$\Delta(e + p^f - p)_t$	0.020	1.044***	0.251	1.192	-0.117
	$e + p^f - p$	0.160	1.711***	0.938	1.022	0.076
$\Delta(\boldsymbol{va_i - p})_t$ (with *x* and *m*)	$\Delta(e + p^f - p)_t$	-0.080	0.228***	0.188	-0.032	0.159**
	$e + p^f - p$	0.308	0.730	-7.600	0.862	0.730
$\Delta(\boldsymbol{w_i - p})_t$ (with *x* and *m*)	$\Delta(e + p^f - p)_t$	-0.043	-0.000	-0.011	-0.042	-0.119**
	$e + p^f - p$	-0.065	-0.128	-0.132	-0.185	-0.410
$\Delta \boldsymbol{emp_{it}}$ (with *x* and *m*)	$\Delta(e + p^f - p)_t$	-0.124***	-0.029	0.036	0.057	0.005
	$e + p^f - p$	0.162	0.211	0.179	-0.176	0.580*

Table 3.16 Signs and Significance of the Exchange Rate Coefficients

Sectors	Profit equation		Value added equation		Wage equation		Employment equation	
	Short run	Long run	Short run	Long run	Short run	Long run	Short run	Long run
AGRICULTURE, HUNTING, FORESTRY AND FISHING	+	+	+	+	+	+	-	+
MINING AND QUARRYING	+	+	-	-	-	-	-	+
MANUFACTURING	+	+	+	+	-	-	+	+
ELECTRICITY GAS AND, WATER SUPPLY	-	-	-	-	-	-	-	+
CONSTRUCTION	-	-	-	-	-	-	-	-
WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS	+	+	-	+	-	-	-	-
TRANSPORT, STORAGE AND COMMUNICATIONS	+	+	+	-	-	-	-	-
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	+	-	-	+	-	-	-	-
COMMUNITY, SOCIAL AND PERSONAL SERVICES	+	+	-	-	-	-	-	-
NON-AGRICULTURE BUSINESS SECTOR	+	+	+	+	+	-	-	-
BUSINESS SECTOR SERVICES	+	+	-	+	-	-	-	-
TOTAL SERVICES	+	+	-	-	-	-	-	-
TOTAL	+	+	+	+	-	-	-	-
Manufacturing subsectors								
Food products, beverages and tobacco	-	+	+	+	-	-	-	+
Textiles, textile products, leather and footwear	+	+	+	+	-	-	+	+
Wood and products of wood and cork	+	+	+	+	-	-	+	+
Pulp, paper, paper products, printing and publishing	+	+	+	+	-	-	+	-
Chemical, rubber, plastics and fuel products	+	+	+	+	-	+	+	-
Other non-metallic mineral products	+	+	+	+	-	+	-	+
Basic metals and fabricated metal products	+	+	+	+	-	-	+	+
Machinery and equipment	+	+	+	+	-	+	+	+
Transport equipment	+	+	-	-	-	-	+	-
Manufacturing nec.; Recycling	-	+	+	+	-	-	+	+

Note:

Positive and significant at the 1 percent significance level.

Positive and significant at the 5 percent significance level.

Positive and significant at the 10 percent significance level.

Negative and significant at the 1 percent significance level.

Negative and significant at the 5 percent significance level.

Negative and significant at the 10 percent significance level.

References

Adler, M., Dumas, B. (1984); "Exposure to currency risk: definition and measurement," *Financial Management*, 13, pp. 41–50

Alesina, Alberto; Ardagna, Silvia; Perotti, Roberto; Schiantarelli, Fabio (2002); "Fiscal Policy, Profits, and Investment," *American Economic Review*, v. 92, iss. 3, pp. 571-89

Allayannis, George; Ihrig, Jane (2001); "Exposure and Markups," *Review of Financial Studies*, v. 14, iss. 3, pp. 805-35

Allayannis, George; Ihrig, Jane; Weston, James P. (2001); "Exchange-Rate Hedging: Financial versus Operational Strategies," *American Economic Review*, v. 91, iss. 2, pp. 391-95

Allayannis, George; Ofek, Eli; "Exchange Rate Exposure, Hedging, and the Use of Foreign Currency Derivatives," *Journal of International Money and Finance*, v. 20, iss. 2, pp. 273-96

Anthony, R. (1973); "Accounting for the cost of equity", Harvard Business Review 51, 88-102.

Ardagna, Silvia (2007); "Fiscal Policy in Unionized Labor Markets," *Journal of Economic Dynamics and Control*, v. 31, iss. 5, pp. 1498-1534

Arellano, Manuel; Bond, Stephen (1991); "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, v. 58, iss. 2, pp. 277-97

Arellano, Manuel; Bover, Olympia (1995); "Another Look at the Instrumental Variable Estimation of Error-Components Models," *Journal of Econometrics*, v. 68, iss. 1, pp. 29-51

Arnold, Jens M.; Bassanini, Andrea; Scarpetta, Stefano (2007); "Solow or Lucas?: Testing Growth Models Using Panel Data from OECD Countries," December 2007, OECD working paper No. 592.

Asteriou, Dimitrios; Price, Simon (2005); "Uncertainty, Investment and Economic Growth: Evidence from a Dynamic Panel," *Review of Development Economics*, v. 9, iss. 2, pp. 277-88

Atella, Vincenzo; Atzeni, Gianfranco Enrico; Belvisi, Pier Luigi (2003); "Investment and Exchange Rate Uncertainty," *Journal of Policy Modeling*, v. 25, iss. 8, pp. 811-24

Baek, Jungho; Koo, Won W. (2006); “Dynamics in the Macroeconomy and the U.S. Agricultural Trade Balance,” *Agribusiness & Applied Economics Report*, December 2006, No. 596

Bahmani-Oskooee, Mohsen; Mirzaie, Aghdas (2000); “The Long-Run Effects of Depreciation of the Dollar on Sectoral Output,” *International Economic Journal*, v. 14, iss. 3, pp. 51-61

Bahmani-Oskooee, Mohsen; Miteza, Ilir (2003); “Are Devaluations Expansionary or Contractionary? A Survey Article” *Economic Issues*, v. 8, iss. 2, pp. 1-28

Bahmani-Oskooee, Mohsen; Miteza, Ilir (2006); “Are Devaluations Contractionary? Evidence from Panel Cointegration,” *Economic Issues*, v. 11, iss. 1, pp. 49-64

Bahmani-Oskooee, Mohsen; Kandil, Magda E. (2007); “Exchange Rate Fluctuations and Output in Oil-Producing Countries: The Case of Iran,” pp. 32 pages, International Monetary Fund, IMF Working Papers: 07/113

Bahmani-Oskooee, Mohsen; Mirzaie, Ida A.; Miteza, Ilir (2007); “Sectoral Employment, Wages and the Exchange Rate: Evidence from the U.S.,” *Eastern Economic Journal*, v. 33, iss. 1, pp. 125-36

Banerjee, A., Dolado, J., Mestre, R. (1998); “Error-correction mechanism tests for cointegration in single-equation framework”, *Journal of Time Series Analysis*, 19, pp. 267–83

Barbone, Luca; Rivera-Batiz, Francisco (1987); “Foreign Capital and the Contractionary Impact of Currency Devaluation, with an Application to Jamaica,” *Journal of Development Economics*, v. 26, iss. 1, pp. 1-15

Bartram, Sohnke M. (2008); “What Lies Beneath: Foreign Exchange Rate Exposure, Hedging and Cash Flows,” *Journal of Banking and Finance*, v. 32, iss. 8, pp. 1508-21

Baum, Christopher F. (2006), *An Introduction to Modern Econometrics Using Stata*, Texas: Stata Press.

Belke, Ansgar; Gros, Daniel (2001); “Real Impacts of Intra-European Exchange Rate Variability: A Case for EMU?” *Open Economies Review*, v. 12, iss. 3, pp. 231-64

Belke, Ansgar; Gros, Daniel (2002a); “Designing EU-US Atlantic Monetary Relations: Exchange Rate Variability and Labour Markets,” *World Economy*, v. 25, iss. 6, pp. 789-813

Belke, Ansgar; Gros, Daniel (2002); “Monetary Integration in the Southern Cone,” *North American Journal of Economics and Finance*, v. 13, iss. 3, pp. 323-49

Belke, Ansgar; Setzer, Ralph (2003); “Exchange Rate Variability and Labor Market Performance in the Visegrad Countries,” *Economics of Planning*, v. 36, iss. 2, pp. 153-75

Belke, Ansgar; Kaas, Leo (2004); “Exchange Rate Movements and Employment Growth: An OCA Assessment of the CEE Economies,” *Empirica*, v. 31, iss. 2-3, pp. 247-80

Berman, Nicolas; Berthou, Antoine (2009); “Financial Market Imperfections and the Impact of Exchange Rate Movements on Exports,” *Review of International Economics*, v. 17, iss. 1, pp. 103-20

Bhandari, Rabindra; Upadhyaya, Kamal P. (2010); “Panel Data Evidence of the Impact of Exchange Rate Uncertainty on Private Investment in South-East Asia”, *Applied Economics*, v. 42, iss. 1-3, pp. 57-61

Biddle, Gary C.; Bowen, Robert M.; Wallace, James S. (1997); “Does EVA Beat Earnings? Evidence on Associations with Stock Returns and Firm Values”; *Journal of Accounting and Economics*, v. 24, iss. 3, pp. 301-36

Binder, Michael; Offermanns, Christian (2007); “International Investment Positions and Exchange Rate Dynamics: A Dynamic Panel Analysis,” CESifo Working Paper series No. 2095.

Bodnar, Gordon M.; Gentry, William M. (1993); “Exchange Rate Exposure and Industry Characteristics: Evidence from Canada, Japan, and the USA,” *Journal of International Money and Finance*, v. 12, iss. 1, pp. 29-45

Bodnar, Gordon M.; Dumas, Bernard; Marston, Richard C. (2002); “Pass-Through and Exposure,” *Journal of Finance*, v. 57, iss. 1, pp. 199-231

Bound, John; Jaeger, David A.; Baker, Regina (1993); “The Cure Can Be Worse than the Disease: A Cautionary Tale Regarding Instrumental Variables,” National Bureau of Economic Research, Inc, NBER Technical Working Paper: 137

Bound, John; Jaeger, David A.; Baker, Regina M. (1995); “Problems with Instrumental Variables Estimation When the Correlation between the Instruments and the Endogenous Explanatory Variable Is Weak,” *Journal of the American Statistical Association*, v. 90, iss. 430, pp. 443-50

Branson, William H.; Love, James P. (1986); “Dollar Appreciation and Manufacturing Employment and Output,” National Bureau of Economic Research, Inc, NBER Working Papers: 1972

Branson, William H.; Love, James P. (1988); “The Real Exchange Rate, Employment, and Output in Manufacturing in the U.S. and Japan,” National Bureau of Economic Research, Inc, NBER Working Papers: 2491

Burda, Michael C.; Gerlach, Stefan (1992); “Intertemporal Prices and the U.S. Trade Balance,” *American Economic Review*, v. 82, iss. 5, pp. 1234-53

Burgess, Simon M.; Knetter, Michael M. (1998); “An International Comparison of Employment Adjustment to Exchange Rate Fluctuations,” *Review of International Economics*, v. 6, iss. 1, pp. 151-63

Burstein, Ariel; Eichenbaum, Martin; Rebelo, Sergio (2005); “Large Devaluations and the Real Exchange Rate,” *Journal of Political Economy*, v. 113, iss. 4, pp. 742-84

Byrne, Joseph P.; Davis, E. Philip (2003); “Exchange Rate Uncertainty on Investment in the Major Industrial Countries”, NIESR and Brunel University, disscussion paper.

Byrne, Joseph P.; Davis, E. Philip (2005a); “The Impact of Short- and Long-Run Exchange Rate Uncertainty on Investment: A Panel Study of Industrial Countries,” *Oxford Bulletin of Economics and Statistics*, v. 67, iss. 3, pp. 307-29

Byrne, Joseph P.; Davis, E. Philip (2005b); “Investment and Uncertainty in the G7”, *Review of World Economics/Weltwirtschaftliches Archiv*, v. 141, iss. 1, pp. 1-32

Campa, Joe Manuel (1993); “Entry by Foreign Firms in the United States under Exchange Rate Uncertainty”, *Review of Economics and Statistics*, v. 75, iss. 4, pp. 614-22

Campa, Jose; Goldberg, Linda S. (1995); “Investment in Manufacturing, Exchange Rates and External Exposure,” *Journal of International Economics*, v. 38, iss. 3-4, pp. 297-320

Campa, Jose Manuel and Goldberg, Linda S. (1999); “Investment, Pass-Through, and Exchange Rates: A Cross-Country Comparison,” *International Economic Review*, v. 40, iss. 2, pp. 287-314

Campa, Jose Manuel; Goldberg, Linda S. (2001); “Employment versus Wage Adjustment and the U.S. Dollar,” *Review of Economics and Statistics*, v. 83, iss. 3, pp. 477-89

Campa, Jose Manuel; Gonzalez Minguez, Jose M. (2006); “Differences in Exchange Rate Pass-Through in the Euro Area,” *European Economic Review*, v. 50, iss. 1, pp. 121-45

Carpenter, Robert E.; Guariglia, Alessandra (2008); “Cash Flow, Investment, and Investment Opportunities: New Tests Using UK Panel Data”; *Journal of Banking and Finance*, v. 32, iss. 9, pp. 1894-1906

Chirinko, R. B. (1993); “Business Fixed Investment Spending: Modeling Strategies, Empirical Results, and Policy Implications,” *Journal of Economic Literature*, v. 31, pp. 1875-911

Choi, Jongmoo Jay; Prasad, Anita Mehra (1995); “Exchange Risk Sensitivity and Its Determinants: A Firm and Industry Analysis of U.S. Multinationals,” *Financial Management*, v. 24, iss. 3, pp. 77-88

Chowdhury, Abdur R.; Wheeler, Mark (2008); “Does Real Exchange Rate Volatility Affect Foreign Direct Investment? Evidence from Four Developed Economies”, *International Trade Journal*, v. 22, iss. 2, pp. 218-45

Clarida, Richard H. (1997); “The Real Exchange Rate and US Manufacturing Profits: A Theoretical Framework with Some Empirical Support,” *International Journal of Finance and Economics*, v. 2, iss. 3, pp. 177-87

Darby, Julia; Hallet, Andrew Hughes; Ireland, Jonathan and Piscitelli, Laura (1999); “The Impact of Exchange Rate Uncertainty on the Level of Investment,” *Economic Journal*, v. 109, iss. 454, pp. C55-67

Davidson, Russell; MacKinnon, James G. (1993); Estimation and inference in econometrics, pp. xx, 874, Oxford; New York; Toronto and Melbourne: Oxford University Press

Delong, J. Bradford; Summers, Lawrence H. (1991); “Equipment Investment and Economic Growth,” *Quarterly Journal of Economics*, v. 106, iss. 2, pp.445-502

De Loo, Ivo; Ziesemer, Thomas (2001); “Determinants of Sectoral Average Wage and Employment Growth Rates in a Specific Factors Model with Production Externalities and International Capital Movements,” Technology and the future of European employment, 2001, pp. 352-86, Cheltenham, U.K. and Northampton, Mass.: Elgar; distributed by American International Distribution Corporation, Williston, Vt.

Devereux, Michael B.; Engel, Charles; Storgaard, Peter E. (2004); “Endogenous exchange rate pass-through when nominal prices are set in advance,” *Journal of International Economics*, v. 63, pp. 263-291

Diaz-Alejandro, Carlos (1988); “A Note on the Impact of Devaluation and the Redistributive Effect,” Trade, development and the world economy: Selected essays of Carlos F. Diaz-Alejandro, pp. 5-10, Edited by Andres Velasco Oxford and New York: Blackwell

Dohring, Bjorn (2008); “Hedging and Invoicing Strategies to Reduce Exchange Rate Exposure: A Euro-Area Perspective,” European Economy - Economic Papers No.299, Directorate General Economic and Monetary Affairs, European Commission

Dominguez, Kathryn M. E.; Tesar, Linda L. (2006); “Exchange Rate Exposure,” *Journal of International Economics*, v. 68, iss. 1, pp. 188-218

Dornbusch, Rudiger; Fischer, Stanley (1986); “The Open Economy: Implications for Monetary and Fiscal Policy,” The American business cycle: Continuity and change, pp. 459-501, National Bureau of Economic Research Studies in Business Cycles series, vol. 25 Chicago and London: University of Chicago Press

Dornbusch, Rudiger (1987); “Exchange Rates and Prices,” *American Economic Review*, v. 77, iss. 1, pp. 93-106

Dombusch, Rudiger (1987a); "Exchange Rate Economics: 1986," *The Economic Journal*, pp. 1-18

Dornbusch, Rudiger (1988); Open Economy Macroeconomics, 2nd edition, New York

Dumenil, Gerard; Glick, Mark; Levy, Dominique (1993); “The Rise of the Rate of Profit During World War II,” *Review of Economics and Statistics*, v. 75, iss. 2, pp. 315-20

Eaton, Jonathan; Kortum, Samuel (2001); “Trade in Capital Goods,” *European Economic Review*, v. 45, iss. 7, pp. 1195-1235

Edwards, Sebastian (1985); “Are Devaluations Contractionary?” National Bureau of Economic Research, Inc, NBER Working Papers: 1676

Ellis, Luci; Smith, Kathryn (2007); “The Global Upward Trend in the Profit Share,” BIS Working Papers, No. 231

Fazzari, S. M.; R. G. Hubbard, and B.C. Petersen (1988); “Financing Constraint and Corporate Investment,” *Brookings Papers on Economic Activity*, v. 1, pp. 141-95

Feenstra, Robert C. (1989); “Symmetric Pass-Through of Tariffs and Exchange Rates under Imperfect Competition: An Empirical Test,” *Journal of International Economics*, v. 27, iss. 1-2, pp. 25-45

Feenstra, Robert C. (1998); “Integration of Trade and Disintegration of Production in the Global Economy,” *Journal of Economic Perspectives*, v. 12, iss. 4, pp. 31-50

Finn, Mary G. (1998); “Cyclical Effects of Government's Employment and Goods Purchases,” *International Economic Review*, v. 39, iss. 3, pp. 635-57

Fisher, E. O'N. (2004); “Why are we losing manufacturing jobs?” Federal Reserve Bank of Cleveland Economy Commentary.

Forbes, Kristin J. (2002a); “Cheap Labor Meets Costly Capital: The Impact of Devaluations on Commodity Firms,” *Journal of Development Economics*, v. 69, iss. 2, pp. 335-65

Forbes, Kristin J. (2002b); “How Do Large Depreciations Affect Firm Performance?” *IMF Staff Papers*, v. 49, pp. 214-38

Frankel, Jeffrey A.; Parsley, David C.; Wei, Shang-Jin (2005); “Slow Passthrough Around the World: A New Import for Developing Countries?” National Bureau of Economic Research, Inc, NBER Working Papers: 11199

Friberg, Richard; Ganslandt, Mattias (2007); “Exchange Rates and Cash Flows in Differentiated Product Industries: A Simulation Approach”; *Journal of Finance*, v. 62, iss. 5, pp. 2475-2502

Gagnon, Joseph E. (2006); “The Effect of Exchange Rates on Prices, Wages, and Profits: A Case Study of the United Kingdom in the 1990s,” *International Economic Journal*, v. 20, iss. 2, pp. 149-60

Gilchrist, Simon; Himmelberg, Charles P. (1995); “Evidence on the Role of Cash Flow for Investment,” *Journal of Monetary Economics*, v. 36, iss. 3, pp. 541-72

Giovannini, Alberto (1988); “Exchange Rates and Traded Goods Prices,” *Journal of International Economics*, v. 24, iss. 1/2, pp. 45-68

Glick, Reuven; Hutchison, Michael M. (1990); “Does Exchange Rate Appreciation 'Deindustrialize' the Open Economy? A Critique of U.S. Evidence,” *Economic Inquiry*, v. 28, iss. 1, pp. 19-37

Goldberg, Linda S. (1993); “Exchange Rates and Investment in United States Industry,” *Review of Economics and Statistics*, v. 75, iss. 4, pp. 575-88

Goldberg, Linda; Tracy, Joseph (1999); “Exchange Rates and Local Labor Markets,” National Bureau of Economic Research, Inc, NBER Working Papers: 6985

Goldberg, Linda; Tracy, Joseph (2001); “Exchange Rates and Wages,” National Bureau of Economic Research, Inc, NBER Working Papers: 8137

Griffin, John M.; Stulz, Rene M. (2001); “International Competition and Exchange Rate Shocks: A Cross-Country Industry Analysis of Stock Returns,” *Review of Financial Studies*, v. 14, iss. 1, pp. 215-41

Guitian, Manuel (1976); “The Effects of Changes in the Exchange Rate on Output, Prices and the Balance of Payments,” *Journal of International Economics*, v. 6, iss. 1, pp. 65-74

Gylfason, Thorvaldur; Schmid, Michael (1983); “Does Devaluation Cause Stagflation?” *Canadian Journal of Economics*, v. 16, iss. 4, pp. 641-54

Gylfason, Thorvaldur; Risager, Ole (1984); “Does Devaluation Improve the Current Account?” *European Economic Review*, v. 25, iss. 1, pp. 37-64

Im, Kyung So; Pesaran, M. Hashem; Shin, Yongcheol (2003); “Testing for Unit Roots in Heterogeneous Panels” *Journal of Econometrics*, v. 115, iss. 1, pp. 53-74

Hahn, Elke (2007); “The Impact of Exchange Rate Shocks on Sectoral Activity and Prices in the Euro Area,” European Central Bank working paper series No. 796,

Hallett, Andrew Hughes; Peersman, Gert; Piscitelli, Laura (2004); “Investment under Monetary Uncertainty: A Panel Data Investigation,” *Empirica*, v. 31, iss. 2-3, pp. 137-62

Harchaoui, Tarek; Tarkhani, Faouzi and Yuen, Terence (2005); “The Effects of the Exchange Rate on Investment: Evidence from Canadian Manufacturing Industries,” working paper.

Harris, R. and R. Sollis. (2003); *Applied Time Series Modelling and Forecasting*, West Sussex: Wiley.

Himarios, Daniel (1993); “The Exchange Rate and U.S. Wage Process: An Intensive Empirical Investigation,” *Journal of Money, Credit, and Banking*, v. 25, iss. 1, pp. 96-108

Hirschman, Albert (1949); “Devaluation and the Trade Balance: A Note,” *Review of Economics and Statistics*, Vol. 31, pp. 50-53

Hsing, Yu (2006); “Responses of Output in Poland to Shocks to the Exchange Rate, the Stock Price, and Other Macro-economic Variables: A VAR Model,” *Applied Economics Letters*, v. 13, iss. 15, pp. 1017-22

Hua, Ping (2007); “Real Exchange Rate and Manufacturing Employment in China,” *China Economic Review*, v. 18, iss. 3, pp. 335-53

Huang, Gene (1997); *Determinants of United States-Japanese foreign direct investment: a comparison across countries and industries*, Taylor & Francis.

Hung, Juann (1992-93); “Assessing the Exchange Rate's Impact on U.S. Manufacturing Profits,” *Federal Reserve Bank of New York Quarterly Review*, v. 17, iss. 4, pp. 44-63

Hung, Juann H. (1997); “The Exchange Rate's Impact on Overseas Profits of U.S. Multinationals,” Journal *of Economics and Business*, v. 49, iss. 5, pp. 439-58

Jorion, P. (1990); “The exchange rate exposure of U.S. multinationals,” *Journal of Business*,v. 63, pp. 33–45.

Kandil, Magda; Mirzaie, Ida (2005); “The Effects of Exchange Rate Fluctuations on Output and Prices: Evidence from Developing Countries,” *Journal of Developing Areas*, v. 38, iss. 2, pp. 189-219

Kim, Byung-Yeon; Korhonen, Iikka (2005); “Equilibrium Exchange Rates in Transition Countries: Evidence from Dynamic Heterogeneous Panel Models,” *Economic Systems*, v. 29, iss. 2, pp. 144-62

Kizys, Renatas; Pierdzioch, Christian (2006); “Time-Varying Exchange Rate Exposure and Exchange Rate Pass-Through,” MPRA Paper No. 759

Knetter, Michael M. (1989), “Price Discrimination by U.S. and German Exporters,” *American Economic Review*, v. 79, iss. 1, pp. 198-210

Knetter, Michael M. (1993); “International Comparisons of Price-to-Market Behavior,” *American Economic Review*, v. 83, iss. 3, pp. 473-86

Krugman, Paul R.; Taylor, Lance (1978); “Contractionary Effects of Devaluation,” *Journal of International Economics*, v. 8, iss. 3, pp. 445-56

Lafrance, Robert; Tessier, David (2001); “Exchange Rate Variability and Investment in Canada, ” working paper.

Landon, Stuart; Smith, Constance E. (2006); “The Exchange Rate and Wages: How They Affect Capital Investment,” The Conference Board of Canada Report

Landon, Stuart; Smith, Constance E. (2008); “Investment and the Exchange Rate: Short Run and Long Run Aggregate and Sector-Level Estimates,” working paper.

Levin, Andrew; Lin, Chien-Fu; Chu, Chia-Shang James (2002); “Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties,” *Journal of Econometrics*, v. 108, iss. 1, pp. 1-24

Lipsey, Robert E. (2006); “Measuring International Trade in Services”, National Bureau of Economic Research, Inc, NBER Working Papers: 12271

Mann, Catherine L. (1986); “Prices, Profit Margins, and Exchange Rates,” *Federal Reserve Bulletin*, v. 72, iss. 6, pp. 366-79

Marston, Richard C. (1990); “Pricing to Market in Japanese Manufacturing,” *Journal of International Economics*, v. 29, iss. 3-4, pp. 217-36

Marston, R. (2001); “The effects of industrial structure on economic exposure,” *Journal of International Money and Finance*, v. 20, pp. 149–164.

Meade, James E. (1951), The Theory of International Economic Policy, I: The Balance of Payment, Oxford University Press, Oxford

McDonald, James Ted (1999); “The Determinants of Firm Profitability in Australian Manufacturing” *Economic Record*, v. 75, iss. 229, pp. 115-26

McKinnon, Ronald (2005); “Exchange Rate or Wage Changes in International Adjustment? Japan and China versus the United States,” *International Economics and Economic Policy*, v. 2, iss. 2-3, pp. 261-74

Mo, Cindy (2009); “The Impact of Real Exchange Rate Fluctuations on Employment and Wages in Eighteen Different Manufacturing Industries in the United States”, Dissertation, Texas Tech University

Nichols, Austin; Schaffer, Mark (2007); “Clustered Standard Errors in Stata”, Discussion paper.

Nickell, Steven J. (1986); “Dynamic Models of Labour Demand”, *Handbook of labor economics*. Volumes 1, pp. 473-522, Handbooks in Economics series, no. 5 Amsterdam; Oxford and Tokyo: North-Holland; distributed in North America by Elsevier Science, New York

Nordhaus, W. D. (1974); “The Falling Share of Profits,” *Brooking Papers on Economic Activity*, v. 1, pp. 169-217

Nucci, Francesco; Pozzolo, Alberto F. (2001); “Investment and the Exchange Rate: An Analysis with Firm-Level Panel Data,” *European Economic Review*, v. 45, iss. 2, pp. 259-83

O’Byrne, S. F. (1996); “EVA and market value”, *Journal of Applied Corporate Finance*, 9, 116-25.

Okun, Arthur M.; Perry, George L. (1970); “Notes and Numbers on the Profits Squeeze,” *Brookings Papers on Economic Activity*, iss. 3, pp. 466-73

Onaran, Ozlem; Yenturk, Nurhan (2001); “Do Low Wages Stimulate Investment? An Analysis of the Relationship between Distribution and Investment in Turkish Private Manufacturing Industry,” *International Review of Applied Economics*, v. 15, iss. 4, pp. 359-74

Ouattara, B. (2004); “The Impact of Project Aid and Program Aid on Domestic Savings: A Case Study of Cote d’Ivoire.” Centre for the Study of African Economies Conference on Growth, Poverty Reduction and Human Development in Africa.

Pesaran M., Pesaran B. (1997); *Working with Microfit 4.0: Interactive Econometric Analysis*, Oxford University Press: Oxford.

Pesaran, M. Hashem; Smith, Ron (1995); “Estimating Long-Run Relationships from Dynamic Heterogeneous Panels,” *Journal of Econometrics*, v. 68, iss. 1, pp. 79-113

Pesaran, Hashem; Smith, Ron; Im, Kyung So (1996); “Dynamic Linear Models for Heterogenous Panels,”The econometrics of panel data: A handbook of the theory with applications, pp. 145-95, Second edition. Advanced Studies in Theoretical and Applied Econometrics, vol. 33. Dordrecht; Boston and London: Kluwer Academic

Pesaran, M. Hashem; Shin, Yongcheol (1998a); "An Autoregressive Distributed-Lag Modelling Approach to Cointegration Analysis Preview", Econometrics and economic theory in the twentieth century: The Ragnar Frisch Centennial Symposium, pp. 371-413, Cambridge; New York and Melbourne: Cambridge University Press

Pesaran, M. Hashem; Smith, Ron P.; Akiyama, Takamasa (1998b); "Energy demand in Asian developing economies," pp. xxiii, 226, Oxford and New York: Oxford University Press for the World Bank and the Oxford Institute for Energy Studies

Pesaran, M. Hashem; Shin, Yongcheol; Smith, Ron P. (1999); "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels," *Journal of the American Statistical Association*, v. 94, iss. 446, pp. 621-34

Pesaran, M., Hashem; Shin, Yongcheol; Smith, Richard J. (2001); "Bounds Testing Approaches to the Analysis of Level Relationships," *Journal of Applied Econometrics*, v. 16, iss. 3, pp. 289-326

Pischke, Jorn-Steffen (2005); "Labor Market Institutions, Wages, and Investment: Review and Implications," *CESifo Economic Studies*, v. 51, iss. 1, pp. 47-75

Revenga, Ana L. (1992); "Exporting Jobs? The Impact of Import Competition on Employment and Wages in U.S. Manufacturing," *Quarterly Journal of Economics*, v. 107, iss. 1, pp. 255-84

Serven, Luis (1995); "Capital Goods Imports, the Real Exchange Rate and the Current Account," *Journal of International Economics*, v. 39, iss. 1-2, pp. 79-101

Shapiro, Alan (1975); ''Exchange-rates changes, inflation, and the value of the multinational corporation.'' *Journal of Finance*, v. 30, pp. 485–502.

Solomons, D. (1965), "Division Performance: Measurement and Control," Financial Executives Research Foundation, New York.

Stephan, Andreas; Tsapin, Andriy (2008); "Persistence and Determinants of Firm Profit in Emerging Markets," *Applied Economics Quarterly*, v. 54, iss. 4, pp. 231-53

Stockhammer, Englebert (2005-2006); "Shareholder Value Orientation and the Investment-Profit Puzzle"; *Journal of Post Keynesian Economics*, v. 28, iss. 2, pp. 193-215

Taylor, Mark P. (1995); "The Economics of Exchange Rates," *Journal of Economic Literature*, v. 33, iss. 1, pp. 13-47

Taylor, Alan M.; Taylor, Mark P. (2004); "The Purchasing Power Parity Debate," *Journal of Economic Perspectives*, v. 18, iss. 4, pp. 135-58

Taylor, Mark P.; Sarno, Lucio (1998); "The Behavior of Real Exchange Rates during the Post-Bretton Woods Period," *Journal of International Economics*, v. 46, iss. 2, pp. 281-312

Toshiko**,** Tange (1997); "Exchange Rates and Export Prices of Japanese Manufacturing," *Journal of Policy Modeling*, v. 19, iss. 2, pp. 195-206

Tsuji, Chikashi (2006); "Does EVA Beat Earnings and Cash Flow in Japan?" *Applied Financial Economics*, v. 16, iss. 16, pp. 1199-1216

Uctum, Merih (1996); "Factors Affecting the Decline in the US Rate of Return: A Sectoral Analysis," Mimeo, FRBNY

Uctum, Merih (1998); "Why Have Corporate Profits Declined? An International Comparison," *Review of International Economics*, v. 6, iss. 2, pp. 234-51

Uctum, Merih; Viana, Sandra (1999); "Decline in the US Profit Rate: A Sectoral Analysis," *Applied Economics*, v. 31, pp. 1641-1652

Upadhyaya, Kamal P. (1999); "Currency Devaluation, Aggregate Output, and the Long Run: An Empirical Study," *Economics Letters*, v. 64, iss. 2, pp. 197-202

Upadhyaya, Kamal P.; Upadhyay, Mukti P. (1999); "Output Effects of Devaluation: Evidence from Asia," Journal *of Development Studies*, v. 35, iss. 6, pp. 89-103

Upadhyaya, Kamal P.; Mixon, Franklin G., Jr.; Bhandari, Rabindra (2004); "Exchange Rate Adjustment and Output in Greece and Cyprus: Evidence from Panel Data," *Applied Financial Economics*, v. 14, iss. 16, pp. 1181-85

Van Den Berg, Hendrik; Lewer, Joshua J. (2006); *International Trade and Economic Growth*, M.E. Sharpe, pp.10-12

Van Ees, Hans; Kuper, Gerard H.; Sterken, Elmer (1996); "Profits, Investment and Business Fluctuations"; *Metroeconomica*, v. 47, iss. 1, pp. 19-33

Van Treeck, Till (2008); "Reconsidering the Investment-Profit Nexus in Finance-Led Economies: An ARDL-Based Approach"; *Metroeconomica*, v. 59, iss. 3, pp. 371-404

Whited, T. M, (1992); "Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data," *Journal of Finance*, v. 47, pp. 1425-60

Williamson, R. (2001); "Exchange rate exposure and competition: evidence from the world automotive industry," *Journal of Financial Economics*, v. 59, pp. 441– 475.

Zakaria, Muhammad; Ahmad, Eatzaz (2009); "Productivity Shocks and Nominal Exchange Rate Variability: A Case Study of Pakistan," *Journal of Economic Integration*, v. 24, iss. 1, pp. 175-89

Appendix A. Measures of Profits

In the OECD *STAN Database for Industrial Analysis*, there are two measures for profits, namely, Gross operating surplus and mixed income (*GOPS*) and Net operating surplus and mixed income (*NOPS*). They are respectively defined as follows:

$$GOPS = \text{Value added at current prices } (VALU) - \text{Compensation of employees } (LABR)$$
$$- \text{Other taxes less subsidies on production } (OTXS)$$

$$NOPS = GOPS - \text{Consumption of fixed capital } (CFCC)$$

In addition, according to the US Bureau of Economic Analysis' (BEA) *Survey of Current Business* (Selected NIPA Tables (March 2011), pp. D-18), Profits from current production (Corporate profits with inventory valuation and capital consumption adjustments) is a subset of *NOPS*, and accounts for roughly 75%-78% of *NOPS* for the US. In this regard, using *NOPS* as the measure of profits will make the estimation results more comparable with the findings in previous studies which usually adopt corporate profits as the profit measure. However, data for *NOPS* is unavailable in the *STAN Database* for five countries, namely, Australia, Canada, Spain, the UK, and the US, and also for certain sectors or manufacturing subsectors in the remaining 15 countries. As a result, we may consider *GOPS* as an alternative to *NOPS* as the measure of profits.

For the 15 countries for which *NOPS* data is available, *GOPS* and *NOPS* are shown to be highly correlated, with correlation coefficients greater than 0.94 for all sectors and nine manufacturing subsectors, with the only exception of the subsector *Transport equipment*, which has a correlation coefficient of 0.81 between these two variables. In this regard, *GOPS* can be considered an appropriate proxy for *NOPS*. However, there is still a serious problem with the use of *GOPS* as the measure of profits. Since data for *OTXS,* and in turn, for *GOPS* is generally unavailable for most of the sample countries during the 1970s to even the 1990s, the sample size will shrink substantially compared to the sample size in the value added case or the wage and employment case. Consequently, the estimation results obtained from all three chapters may not be comparable with one another due to large differences in the samples.

By calculating for each sector the correlation coefficient between *GOPS* and (*VALU* - *LABR*), which is considered a proxy for *GOPS*, and running a trial regression over the same sample period with (*VALU* - *LABR*) in place of *GOPS* as the dependent variable, I find an extremely high and significant correlation (>0.97) between these two profit measures in all sectors (since *OTXS* in general accounts for only 10%-20% in value added and is fairly stable over time), and that the estimation results obtained using both measures are very similar. Therefore, (*VALU* - *LABR*) can be supported as a perfect proxy for *GOPS* as a measure of profits. Moreover, (*VALU* - *LABR*) also has a clear advantage over GOPS as the profit measure in having a much larger sample size. This will undoubtedly facilitate the comparison of estimation results across chapters. Also, as the sample size expands, one should reasonably expect the estimation results with *GOPS* as the profit measure to eventually converge to those with (*VALU* - *LABR*) as the profit measure.

Appendix B. Sectors and Subsectors of Manufacturing

Table B Sectors and subsectors of Manufacturing

ISIC Rev.3	Sector Name
01-05	**AGRICULTURE, HUNTING, FORESTRY AND FISHING**
10-14	**MINING AND QUARRYING**
15-37	**MANUFACTURING**
15-16	Food products, beverages and tobacco
17-19	Textiles, textile products, leather and footwear
20	Wood and products of wood and cork
21-22	Pulp, paper, paper products, printing and publishing
23-25	Chemical, rubber, plastics and fuel products
26	Other non-metallic mineral products
27-28	Basic metals and fabricated metal products
29-33	Machinery and equipment
34-35	Transport equipment
36-37	Manufacturing nec.; Recycling
40-41	**ELECTRICITY, GAS AND WATER SUPPLY**
45	**CONSTRUCTION**
50-55	**WHOLESALE AND RETAIL TRADE; RESTAURANTS AND HOTELS**
60-64	**TRANSPORT, STORAGE AND COMMUNICATIONS**
65-74	**FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES**
75-99	**COMMUNITY SOCIAL AND PERSONAL SERVICES**
10-41	**Industry including energy**
10-67, 71-74	**NON-AGRICULTURE BUSINESS SECTOR**
50-74	**BUSINESS SECTOR SERVICES**
50-99	**TOTAL SERVICES**
	TOTAL

Source: OECD STAN Database for Industrial Analysis

Appendix C. Observations per Country for Each Sector

Table C. Observations per Country for Each Sector

Sectors	Agriculture, hunting, forestry and fishing		Mining and quarrying		Manufacturing		Food products, beverages and tobacco		Textiles, textile products, leather and footwear		Wood and products of wood and cork		Pulp, paper, paper products, printing and publishing	
	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs
Australia	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36
Austria	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33
Belgium	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
Canada	71-05	35	71-05	35	71-05	35	71-05	35	71-05	35	71-05	35	71-05	35
Denmark	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
Finland	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
France	71-08	38	-	-	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
Germany	91-08	18	91-08	18	91-08	18	91-08	18	91-08	18	91-08	18	91-08	18
Greece	95-08	14	95-08	14	70-03	34	70-03	34	70-03	34	70-03	34	70-03	34
Ireland	86-08	23	86-08	23	85-08	24	85-08	24	85-08	24	85-08	24	85-08	24
Italy	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
Japan	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36
Netherlands	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
New Zealand	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36
Norway	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
Portugal	77-06	30	-	-	77-06	30	77-06	30	77-06	30	77-06	30	77-06	30
Spain	80-08	29	80-08	29	78-08	31	78-08	31	78-08	31	78-08	31	78-08	31
Sweden	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
UK	71-08	38	71-07	37	71-08	38	71-07	37	71-07	37	71-07	37	71-07	37
USA	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37
Total		669		600		692		691		691		691		691
Average		33.5		33.3		34.6		34.6		34.6		34.6		34.6

Note: Data are obtained from the OECD STAN Database for Industrial Analysis for the sample period 1970-2006.

Chemical, rubber, plastics and fuel products		**Other non-metallic mineral products**		**Basic metals and fabricate metal products**		**Machinery and equipment**		**Transport equipment**		**Manufacturing nec.; Recycling**		**Electricity, gas and water supply**		**Construction**	
Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs
71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36
76-08	33	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
71-05	35	71-05	35	71-05	35	71-05	35	71-05	35	71-05	35	71-05	35	71-05	35
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-07	37	71-07	37
91-08	18	91-08	18	91-08	18	91-08	18	91-08	18	91-08	18	91-08	18	91-08	18
70-03	34	70-03	34	70-03	34	70-03	34	70-03	34	70-03	34	95-08	14	95-08	14
85-08	24	85-08	24	85-08	24	85-08	24	85-08	24	85-08	24	86-08	23	86-08	23
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36	71-06	36
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
77-06	30	77-06	30	77-06	30	77-06	30	77-06	30	77-06	30	77-06	30	77-06	30
78-08	31	78-08	31	78-08	31	78-08	31	78-08	31	78-08	31	80-08	29	80-08	29
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-08	38
71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37
	691		691		691		691		691		691		667		668
	34.6		34.6		34.6		34.6		34.6		34.6		33.4		33.4

Wholesale and retail trade; Restaurants and hotels		Transport, storage and communications		Finance, insurance, real estate and business services		Community social and personal services		Non-agriculture business sector		Business sector services		Total services		Total	
Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs	Years	Obs
71-06	36	71-06	36	71-06	36	71-06	36	89-06	18	71-06	36	71-06	36	71-06	36
76-08	33	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33	76-08	33
71-08	38	71-08	38	71-08	38	71-08	38	95-08	14	71-08	38	71-08	38	71-08	38
71-05	35	71-05	35	71-05	35	71-05	35	97-05	9	71-05	35	71-05	35	71-05	35
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
71-08	38	71-08	38	71-08	38	71-08	38	75-08	34	71-08	38	71-08	38	71-08	38
71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37	71-07	37
91-08	18	91-08	18	91-08	18	91-08	18	91-07	17	91-08	18	91-08	18	91-08	18
95-08	14	95-08	14	95-08	14	95-08	14	95-08	14	95-08	14	95-08	14	95-08	14
86-08	23	86-08	23	86-08	23	86-08	23	98-07	10	86-08	23	86-08	23	86-08	23
71-08	38	71-08	38	71-08	38	71-08	38	92-08	17	71-08	38	71-08	38	71-08	38
71-06	36	71-06	36	71-06	36	71-06	36	71-05	35	71-06	36	71-06	36	71-06	36
71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38	71-08	38
71-06	36	71-06	36	71-06	36	71-06	36	86-98	13	71-06	36	71-06	36	71-06	36
71-08	38	71-08	38	71-08	38	71-08	38	71-07	37	71-08	38	71-08	38	71-08	38
77-06	30	77-06	30	77-06	30	77-06	30	95-06	12	77-06	30	77-06	30	77-06	30
80-08	29	80-08	29	80-08	29	80-08	29	91-08	18	80-08	29	80-08	29	80-08	29
71-08	38	71-08	38	71-08	38	71-08	38	80-08	29	71-08	38	71-08	38	71-08	38
71-07	37	71-07	37	71-08	38	71-08	38	92-07	16	71-08	38	71-08	38	71-08	38
71-07	37	71-07	37	71-07	37	71-07	37	80-07	28	71-07	37	71-07	37	71-07	37
	667		667		668		668		467		668		668		668
	33.4		33.4		33.4		33.4		23.4		33.4		33.4		33.4

Appendix D. Deriving the General ARDL-ECM Model

An ARDL model with lags (1,1) for the dependent and explanatory variables, y and x, respectively, can be written as follows:

$$y_t = \gamma_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \varepsilon_t \qquad \text{(D.1)}$$

where y_{t-1} and x_{t-1} denote, respectively, the first-period lags of y_t and x_t; γ_1 is the coefficient on y_{t-1}, and $\beta's$ are the coefficients on the current and lagged values of x. ε_t is a well-behaved error term with zero mean and variance σ^2.

Transforming equation (D.1) into the error-correction form gives:

$$\begin{aligned}\Delta y_t &= (\gamma_1 - 1) y_{t-1} + \beta_0 (x_t - x_{t-1}) + (\beta_0 + \beta_1) x_{t-1} + \varepsilon_t \\ &= (\gamma_1 - 1) y_{t-1} + (\beta_0 + \beta_1) x_{t-1} + \beta_0 \Delta x_t + \varepsilon_t\end{aligned} \qquad \text{(D.2)}$$

For an ARDL model with lags (2,2) for the dependent and explanatory variables, respectively, the ARDL to ECM transformation is as follows:

$$\begin{aligned}& y_t = \gamma_1 y_{t-1} + \gamma_2 y_{t-2} + \beta_0 x_t + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \varepsilon_t \Rightarrow \\ & \Delta y_t = \gamma_2 (y_{t-2} - y_{t-1}) + (\gamma_1 + \gamma_2 - 1) y_{t-1} + \beta_0 (x_t - x_{t-1}) + \beta_2 (x_{t-2} - x_{t-1}) \\ & \qquad + (\beta_0 + \beta_1 + \beta_2) x_{t-1} + \varepsilon_t \\ & \quad = (\gamma_1 + \gamma_2 - 1) y_{t-1} + (\beta_0 + \beta_1 + \beta_2) x_{t-1} - \gamma_2 \Delta y_{t-1} + \beta_0 \Delta x_t - \beta_2 \Delta x_{t-1} + \varepsilon_t\end{aligned} \qquad \text{(D.3)}$$

For an ARDL model with lags (3,3) for the dependent and explanatory variables, respectively, the ARDL to ECM transformation is as follows:

$$\begin{aligned}& y_t = \gamma_1 y_{t-1} + \gamma_2 y_{t-2} + \gamma_3 y_{t-3} + \beta_0 x_t + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \beta_3 x_{t-3} + \varepsilon_t \Rightarrow \\ & \Delta y_t = \gamma_3 (y_{t-3} - y_{t-2}) + (\gamma_2 + \gamma_3)(y_{t-2} - y_{t-1}) + (\gamma_1 + \gamma_2 + \gamma_3 - 1) y_{t-1} \\ & \qquad + \beta_0 (x_t - x_{t-1}) + \beta_3 (x_{t-3} - x_{t-2}) + (\beta_2 + \beta_3)(x_{t-2} - x_{t-1}) \\ & \qquad + (\beta_0 + \beta_1 + \beta_2 + \beta_3) x_{t-1} + \varepsilon_t \\ & \quad = (\gamma_1 + \gamma_2 + \gamma_3 - 1) y_{t-1} + (\beta_0 + \beta_1 + \beta_2 + \beta_3) x_{t-1} - \gamma_3 \Delta y_{t-2} - (\gamma_2 + \gamma_3) \Delta y_{t-1} \\ & \qquad + \beta_0 \Delta x_t - (\beta_2 + \beta_3) \Delta x_{t-1} - \beta_3 \Delta x_{t-2} + \varepsilon_t\end{aligned} \qquad \text{(D.4)}$$

Therefore, for a general ARDL model with lags (s,q) for the dependent and explanatory variables, respectively, the ARDL to ECM transformation is as follows:

$$
\begin{aligned}
y_t &= \sum_{j=1}^{s}\gamma_i y_{t-j} + \sum_{j=0}^{q}\beta_j x_{t-j} + \varepsilon_t \Rightarrow \\
\Delta y_t &= \left(\sum_{j=1}^{s}\gamma_j - 1\right) y_{t-1} + \left(\sum_{j=0}^{q}\beta_j\right) x_{t-1} - \sum_{j=1}^{s-1}\left[\left(\sum_{m=j+1}^{s}\gamma_m\right)\Delta y_{t-j}\right] \\
&\quad + \beta_0 \Delta x_t - \sum_{j=1}^{q-1}\left[\left(\sum_{m=j+1}^{q}\beta_m\right)\Delta x_{t-j}\right] + \varepsilon_t \\
&= (\tau - 1) y_{t-1} + \delta x_{t-1} + \sum_{j=1}^{s-1}\lambda_j \Delta y_{t-j} + \beta_0 \Delta x_t + \sum_{l=1}^{q-1}\psi_j \Delta x_{t-j} + \varepsilon_t
\end{aligned}
\tag{D.5}
$$

where y_{t-j} and x_{t-j} represent respectively the *j*-th lags of y_t and x_t;

$(\tau - 1) = \left(\sum_{j=1}^{s}\gamma_j - 1\right)$ is the error-correction coefficient,

$\lambda_j = -\sum_{m=j+1}^{s}\gamma_{im},\ j = 1, 2, \ldots, s-1,$ are the new coefficients on the changes of the dependent variable; $\delta = \sum_{j=0}^{q}\beta_j$,and $\psi_j = -\sum_{m=j+1}^{q}\beta_m,\ j = 1, 2, \ldots, q-1,$ parameters represent the coefficients on the lagged values and changes of the exogenous variables, respectively.

Appendix E. The MG and PMG Estimates

The use of panel data as well as the dynamic panel data models in macroeconomics has gained more and more interest. However, in typical macroeconomic analyses with datasets that tend to have dimensions in N (the number of cross-sectional units) and T (the number of time periods) of roughly the same order (e.g., country panels), the conventional methods of pooled OLS or dynamic fixed-effect models tend to not only lead to spurious regressions due to non-stationarity of the data (Pesaran et al., 1999), but may also overlook the dynamic properties of the model (Kim and Korhonen, 2005); on the other hand, the Arellano-Bond model (Arellano and Bond, 1991; Arellano and Bover, 1995), or the dynamic panel data models with homogeneous slopes, which intend to deal with the small and fixed T problem, is obviously irrelevant, since as T increases, the fixed effects from the initial conditions will decline substantially.

The mean group (MG) and pooled mean group (PMG) approaches to dynamic panel data models with heterogeneous slopes, proposed respectively by Pesaran and Smith (1995) and Pesaran, Shin and Smith (1999), which focus primarily on the long-run effects and the speed of adjustment to the long run, have become practical alternatives in handling the panels with large time and cross-sectional dimensions.

The key idea underlying the MG and PMG estimators is that, unlike in static models, the mean of the slope coefficients cannot be consistently estimated in pooled dynamic heterogeneous panel data models. Extending the cross-section cannot solve this problem but may make it even worse (Asteriou and Price, 2005). Taking this insight into account, the MG estimator is able to consistently estimate the average of the parameters by taking an average of the estimated coefficients obtained from separate regressions for each group (Asteriou and Price, 2005). The PMG estimator, which is an intermediate case between the MG estimator and the traditional pooled estimators (such as the fixed and random effects estimators), even gains some superiority over the MG estimator by taking into account the fact that certain parameters may be the same across groups (Pesaran et al., 1999). Hence, instead of allowing the slope coefficients to differ all along as in the MG model, the PMG model imposes homogeneity on the long-run slope coefficients and only allows the intercepts, short-run coefficients, and error variances to differ from group to group, based on the perspective that common shocks to all groups are more likely to lead to common features in their long-run dynamics than in the short run (Pesaran et al., 1999; Binder and Offermanns, 2007).[61]

When comparing the PMG, MG and DFE (dynamic fixed effects) estimators, the PMG specification, as has been stressed in Pesaran et al. (1999) and Arnold et al. (2007), is superior to the traditional DFE model in that, by imposing homogeneity on the long-run slope coefficients only, short-run dynamic specification is allowed to differ across countries, while the DFE specification assumes homogeneous slope coefficients and allows only the intercepts to differ. The MG estimator, on the other hand, imposes no restriction on the coefficients and is able to provide consistent estimates of the mean of the long-run coefficients, which, however, are inefficient if the parameters are in fact homogeneous (Byrne and Davis, 2003) or in small-country samples, in which the mean of the coefficients can be seriously affected by an outlier (Arnold et al., 2007). Pesaran et al. (1999) thus suggests that a Hausman test with the null hypothesis that the PMG (restricted) and MG (unrestricted) estimates are equivalent while the PMG estimator is more efficient, should be carried out to test for long-run homogeneity. Hence, if the null hypothesis is rejected, the PMG assumption of long-run homogeneity will not hold. In addition, a significantly large difference between these two estimates, may in fact imply misspecification of the model (Byrne and Davis, 2003).

In this current study, the PMG method, which involves running separate regressions for each cross-sectional unit (i.e., each country), is less applicable due to a small sample size. This is because there are only 20 countries included in the sample, and for some countries in this unbalanced panel, such as Germany and Greece, observations begin only in 1991 and 1995 (for all sectors except Manufacturing), respectively. Estimation with such a small sample size, according to Pesaran, Smith and Akiyama (1998), can be very imprecise and finally lead to inaccurate heterogeneity

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[61] For example, an oil price increase in the international market will obviously have different impacts on oil-import and -export countries in the short run. For oil-importing countries, if their production relies heavily on oil, the rise in the oil price will push up the marginal cost of production and, in turn, the product price and export price. For oil-exporting countries, however, they will initially enjoy a higher profit and higher national income due to the oil price increase. But if these countries are also heavily import-dependent (e.g., machinery and equipment), their production costs will soon be brought up through higher import price. Consequently, even if the oil-importing and exporting countries are differently influenced by the oil price shock in the short run, they are both likely, in the long run, to suffer from a higher inflation.

corrected panel estimates. To correct for this problem, Pesaran, Smith and Im (1996) suggest that at least 25 observations should be included in each cross-sectional regression. This requirement, however, cannot be satisfied by the dataset used in this study, as shown in Appendix C which lists the observation periods by country for each sector.

Appendix F. International Trade in Services

Figure F.1 Share of Service Trade in Total International Trade of Goods and Services (non-European countries)

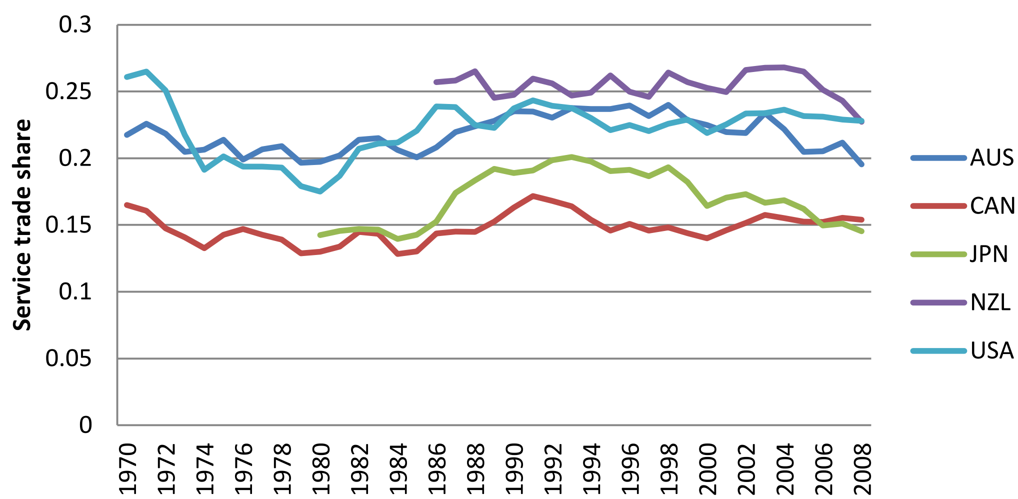
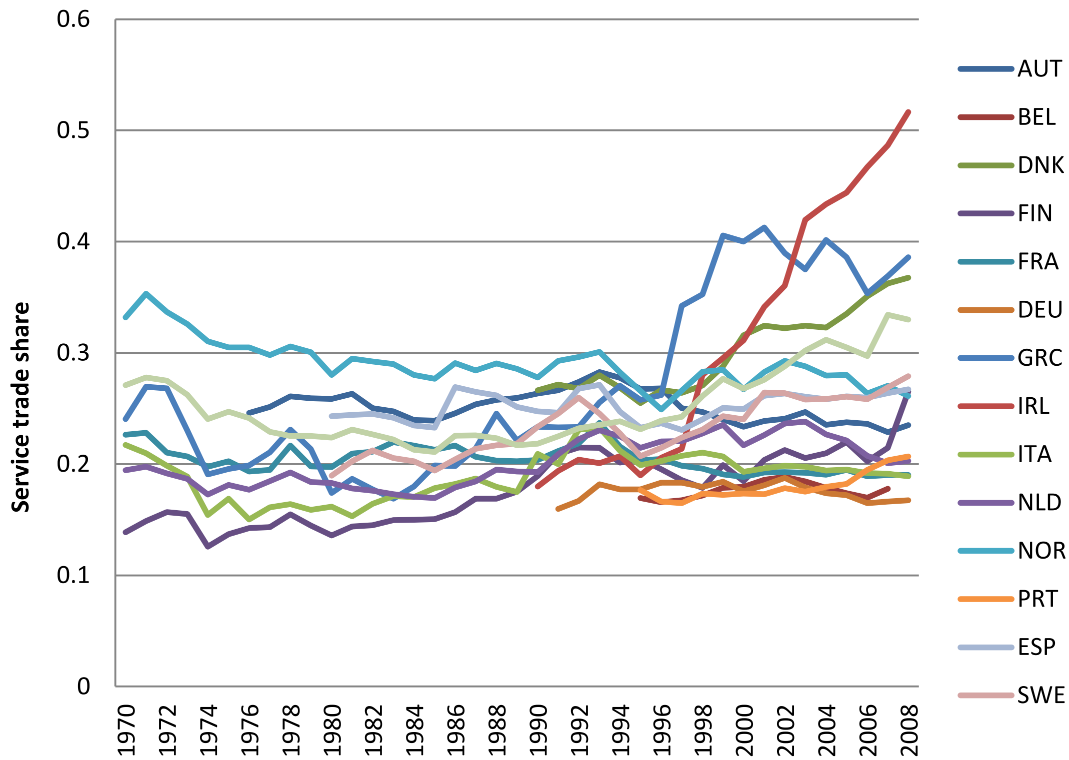


Figure F.2 Share of Service Trade in Total International Trade of Goods and Services (European countries)



Source: Exports and imports of goods and services (1970-2008), Gross Domestic Product: expenditure approach, National Accounts and Historical Statistics, OECD Database.

Table F.1 Service Exports and Imports (%)

Country	Average growth rate of service exports	Average growth rate of service imports	Average share of service exports in total exports	Average share of service imports in total imports
Australia	10.92	9.73	19.29	24.31
Austria	6.66	7.23	30.74	19.58
Belgium	7.20	6.33	17.76	17.49
Canada	8.76	8.67	12.40	17.16
Denmark	8.13	8.31	31.03	29.22
Finland	11.29	11.51	15.62	19.78
France	8.53	8.04	20.96	19.91
Germany	6.99	5.55	13.74	21.37
Greece	17.78	17.01	41.35	12.67
Ireland	17.55	16.17	24.42	38.23
Italy	10.94	11.58	19.57	18.13
Japan	3.80	3.22	11.25	22.80
Netherlands	7.27	7.72	19.95	20.25
New Zealand	5.94	5.30	24.02	26.89
Norway	7.42	9.32	30.36	27.70
Portugal	8.53	6.10	22.46	13.54
Spain	10.44	12.66	33.27	17.11
Sweden	9.79	8.96	21.82	24.68
United Kingdom	10.33	9.80	29.02	21.37
United States	9.44	8.69	26.70	17.72
Average	9.44	9.16	23.45	21.54

Source: Exports and imports of goods and services (1970-2008), Gross Domestic Product: expenditure approach, Main Aggregates, National Accounts and Historical Statistics, OECD Database.

Table F.2 Share in Total Service Trade by Category of Service (%)

Country	CATEGORY OF SERVICE									
	Transportation	Travel	Communication services	Construction services	Insurance services	Computer and information services	Royalties and license fees	Other business services	Personal, cultural and recreational services	Government services, N.I.E
Australia	26.83	43.76	2.88	0.13	2.03	2.94	4.13	10.96	2.35	2.00
Belgium	78.49	22.14	3.81	2.32	1.37	4.09	-6.53	28.86	0.88	2.35
Canada	151.84	27.25	3.25	0.68	7.23	4.68	8.02	25.26	0.31	1.93
Denmark	61.53	16.96	1.61	0.44	0.83	2.66	3.11	14.87	1.79	1.67
Finland	119.40	17.47	2.59	3.06	0.43	6.72	6.64	39.19	0.23	0.81
France	26.09	32.81	2.34	2.63	1.32	1.42	3.83	24.68	2.24	0.97
Germany	21.82	26.83	2.28	4.43	2.16	4.79	3.76	26.98	1.18	2.58
Greece	48.33	32.86	1.91	0.88	2.56	1.07	1.40	7.07	1.41	1.25
Ireland	4.62	9.02	1.48	0.03	11.50	17.57	14.29	33.18	0.41	0.44
Italy	19.11	33.57	3.07	2.76	2.08	1.15	1.42	32.35	1.31	1.77
Japan	32.09	15.89	0.71	5.80	1.59	1.75	13.45	23.46	0.56	1.47
Netherlands	24.09	16.61	3.56	2.52	0.80	3.92	9.14	34.96	0.91	1.84
New Zealand	27.63	44.18	3.29	0.34	1.50	2.50	4.18	12.52	1.58	1.29
Norway	43.81	22.35	1.32	0.42	1.39	3.19	1.58	21.54	1.28	1.11
Portugal	25.48	39.95	3.29	1.97	1.28	1.81	1.94	18.29	2.39	1.68
Spain	21.71	35.30	2.08	1.68	1.29	3.61	2.48	25.40	2.16	0.72
Sweden	17.97	23.96	3.33	1.78	1.50	6.00	5.64	36.02	0.55	0.68
United Kingdom	18.00	25.89	2.98	0.41	2.80	3.51	6.00	24.11	1.36	2.36
United States	21.48	26.16	1.78	0.16	5.54	2.86	11.63	13.97	1.65	7.70
Average (excluding Austria)	41.60	27.00	2.50	1.71	2.59	4.01	5.06	23.88	1.29	1.82

Source: Dataset "Trade in services by category of service" of the OECD Database (2000-2008). The trade shares are calculated as (category exports + category imports)/(total service exports + total service imports), and then averaged across the period 2000-2008 for each sample country.

Appendix G. Estimation Results with Real Value Added

Table G.1 Correlation Coefficients between Value Added Volumes, Real Value Added, Relative Prices, and the Real Exchange Rate

(A) Sectors and Multi-Sector Aggregates

AGRICULTURE, HUNTING, FORESTRY AND FISHING

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.452***		
$\Delta(p_i - p)_t$	-0.332***	0.691***	
$\Delta(e + p^f - p)_t$	-0.005	0.162***	0.167***

MINING AND QUARRYING

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.538***		
$\Delta(p_i - p)_t$	-0.266***	0.669***	
$\Delta(e + p^f - p)_t$	-0.024	0.045	0.059

MANUFACTURING

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.822***		
$\Delta(p_i - p)_t$	-0.094**	0.492***	
$\Delta(e + p^f - p)_t$	0.131***	0.144***	0.116***

ELECTRICITY GAS AND, WATER SUPPLY

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.424***		
$\Delta(p_i - p)_t$	-0.333***	0.713***	
$\Delta(e + p^f - p)_t$	0.052	-0.057	-0.104***

CONSTRUCTION

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.841***		
$\Delta(p_i - p)_t$	-0.021	0.524***	
$\Delta(e + p^f - p)_t$	-0.053	-0.124***	-0.158***

WHOLESALE AND RETAIL TRADE - RESTAURANTS AND HOTELS

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.679***		
$\Delta(p_i - p)_t$	-0.364***	0.437***	
$\Delta(e + p^f - p)_t$	-0.051	-0.021	0.030

TRANSPORT, STORAGE AND COMMUNICATIONS

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.490***		
$\Delta(p_i - p)_t$	-0.502***	0.508***	
$\Delta(e + p^f - p)_t$	0.075*	0.016	-0.052

FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.680***		
$\Delta(p_i - p)_t$	-0.235***	0.553***	
$\Delta(e + p^f - p)_t$	-0.077*	-0.019	0.048

COMMUNITY, SOCIAL AND PERSONAL SERVICES

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.580***		
$\Delta(p_i - p)_t$	-0.076*	0.768***	
$\Delta(e + p^f - p)_t$	0.054	-0.172***	-0.173***

NON-AGRICULTURE BUSINESS SECTOR

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.925***		
$\Delta(p_i - p)_t$	-0.137***	0.251***	
$\Delta(e + p^f - p)_t$	-0.021	-0.023	-0.038

BUSINESS SECTOR SERVICES

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.753***		
$\Delta(p_i - p)_t$	-0.239***	0.460***	
$\Delta(e + p^f - p)_t$	-0.051	-0.019	0.037

TOTAL SERVICES

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.741***		
$\Delta(p_i - p)_t$	-0.161***	0.544***	
$\Delta(e + p^f - p)_t$	-0.065*	-0.085**	-0.046

TOTAL

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.938***		
$\Delta(p_i - p)_t$	0.021	0.365***	
$\Delta(e + p^f - p)_t$	0.019	0.028	0.034

(B) Manufacturing Subsectors

Food products, beverages and tobacco

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.398***		
$\Delta(p_i - p)_t$	-0.581***	0.522***	
$\Delta(e + p^f - p)_t$	0.037	-0.010	-0.069

Textiles, textile products, leather and footwear

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.773***		
$\Delta(p_i - p)_t$	-0.300***	0.374***	
$\Delta(e + p^f - p)_t$	0.144***	0.097***	-0.045

Other non-metallic mineral products

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.793***		
$\Delta(p_i - p)_t$	-0.182***	0.454***	
$\Delta(e + p^f - p)_t$	0.021	-0.008	-0.081*

Basic metals and fabricated metal products

	$\Delta valk_{it}$	$\Delta(va_i - p)_t$	$\Delta(p_i - p)_t$
$\Delta(va_i - p)_t$	0.673***		
$\Delta(p_i - p)_t$	-0.063	0.696***	
$\Delta(e + p^f - p)_t$	0.116***	0.155***	0.142***

Wood and products of wood and cork			
	$\Delta valk_{it}$	$\Delta(va_i-p)_t$	$\Delta(p_i-p)_t$
$\Delta(va_i-p)_t$	0.680***		
$\Delta(p_i-p)_t$	-0.116**	0.652***	
$\Delta(e+p^f-p)_t$	0.088*	0.082**	0.064

Machinery and equipment			
	$\Delta valk_{it}$	$\Delta(va_i-p)_t$	$\Delta(p_i-p)_t$
$\Delta(va_i-p)_t$	0.794***		
$\Delta(p_i-p)_t$	-0.442***	0.194***	
$\Delta(e+p^f-p)_t$	0.101**	0.062*	-0.037

Pulp, paper, paper products, printing and publishing			
	$\Delta valk_{it}$	$\Delta(va_i-p)_t$	$\Delta(p_i-p)_t$
$\Delta(va_i-p)_t$	0.521***		
$\Delta(p_i-p)_t$	-0.275***	0.678***	
$\Delta(e+p^f-p)_t$	0.105**	0.094**	0.031

Transport equipment			
	$\Delta valk_{it}$	$\Delta(va_i-p)_t$	$\Delta(p_i-p)_t$
$\Delta(va_i-p)_t$	0.752***		
$\Delta(p_i-p)_t$	-0.403***	0.301***	
$\Delta(e+p^f-p)_t$	-0.042	-0.032	0.069

Chemical, rubber, plastics and fuel products			
	$\Delta valk_{it}$	$\Delta(va_i-p)_t$	$\Delta(p_i-p)_t$
$\Delta(va_i-p)_t$	0.578***		
$\Delta(p_i-p)_t$	-0.281***	0.621***	
$\Delta(e+p^f-p)_t$	0.102**	0.123***	0.083*

Manufacturing nec.; Recycling			
	$\Delta valk_{it}$	$\Delta(va_i-p)_t$	$\Delta(p_i-p)_t$
$\Delta(va_i-p)_t$	0.800***		
$\Delta(p_i-p)_t$	-0.392***	0.239***	
$\Delta(e+p^f-p)_t$	0.108**	0.004	-0.138***

Note: Δp_{it} is the change in relative price, calculated as the difference between $\Delta(va_i-p)_t$ and $\Delta valk_{it}$.

Table G.2 Estimation Results by Sector, Real Value Added (baseline model, reduced sample)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
Dependent variable: $\Delta(\boldsymbol{va_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	0.666*** (0.132)	0.073 (0.233)	0.241*** (0.067)	-0.185 (0.153)	-0.211** (0.090)
$\Delta(e + p^f - p)_{t-1}$			0.134** (0.056)		-0.193** (0.076)
Δy_t	0.927*** (0.254)	2.008*** (0.642)	1.275*** (0.173)	0.056 (0.214)	1.831*** (0.247)
Δy_{t-1}				-0.636** (0.259)	0.500** (0.182)
$\Delta(w - p)_t$	-0.130 (0.281)	-1.642*** (0.483)	0.023 (0.272)	-0.076 (0.232)	0.309 (0.322)
$\Delta(w - p)_{t-1}$		0.773** (0.356)			
$\Delta(va_i - p)_{t-1}$		0.101** (0.039)	0.079* (0.043)	-0.075* (0.041)	0.186*** (0.045)
Long-run coefficients					
$e + p^f - p$	0.978*** (0.284)	2.163 (3.226)	1.251 (0.534)	-0.327 (0.685)	-1.191*** (0.272)
y	1.065*** (0.343)	-1.790 (3.769)	0.283 (0.324)	0.743 (0.502)	1.817*** (0.295)
$w - p$	-0.726** (0.271)	3.202 (2.543)	0.321 (0.350)	-0.083 (0.417)	-0.383 (0.380)
Adjustment coefficient $(\tau_i - 1)$	-0.228 (0.022)	-0.054 (0.018)	-0.100 (0.042)	-0.144 (0.024)	-0.158 (0.021)
PSS t-test $(k = 3)$	-10.48^^^	-2.99^^	-2.39^	-6.06^^^	-7.62^^^
R^2	0.386	0.460	0.658	0.258	0.620
Number of countries	20	18	20	20	20
Number of observation	592	498	567	564	574
RESET test	0.24	11.09[c]	0.15	42.85[c]	10.31[c]
AR(1) test	-1.41	-0.06	1.03	-0.73	-0.82

Note: The model is estimated over the same sample as value added volumes. Robust-clustered (by country) standard errors in parentheses. The exchange rate coefficients should be multiplied by the average trade share, 0.633, to isolate the exchange rate effects on real value added.

* The estimated coefficient is significant at the 10 percent significance level.

** The estimated coefficient is significant at the 5 percent significance level.

*** The estimated coefficient is significant at the 1 percent significance level.

The critical value bounds for the PSS t-test at the 5% level of significance are (-2.86, -3.78) for $k = 3$, (-2.86, -3.99) for $k = 4$, and (-2.86, -4.19) for $k = 5$, the bounds at the 10% level are (-2.57, -3.46), (-2.57, -3.66) and (-2.57, -3.86) for *k* = 3, 4 and 5, respectively (Pesasan et al., (2001), pp.303, Table CII(iii)).

^ Indicates that the statistic lies below the 0.05 lower bound, so a long-run relationship does not exist at the 5% significance level.

^^ Indicates that the statistic falls within the 0.05 bounds, so a long-run relationship may or may not exist at the 5% significance level.

^^^ Indicates that the statistic lies above the 0.05 upper bound, so a long-run relationship exists at the 5% significance level.

a The null hypothesis of appropriate specification can be rejected at the 10 percent significance level, but not at the 5 or 1 percent significance level.

b The specification can be rejected at the 5 percent significance level, but not at the 1 percent significance level.

c The specification can be rejected at the 1 percent significance level.

d The null hypothesis of no first-order autocorrelation can be rejected a the 10 percent significance level, but not at the 5 or 1 percent significance level.

e The null hypothesis of no first-order autocorrelation can be rejected a the 5 percent significance level, but not at the 1 percent significance level.

f The null hypothesis of no first-order autocorrelation can be rejected a the 1 percent significance level.

Table G.2 Estimation Results by Sector, Real Value Added (baseline model, reduced sample) (continued)

Sectors	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*	*Total economy*
Dependent variable: $\Delta(\boldsymbol{va_i - p})_t$					
Short-run coefficients					
$\Delta(e+p^f-p)_t$	-0.054 (0.072)	0.034 (0.065)	0.023 (0.042)	-0.070** (0.027)	0.059* (0.028)
Δy_t	1.323*** (0.158)	0.336** (0.159)	0.486*** (0.125)	0.133** (0.054)	
Δy_{t-1}			0.195** (0.093)		
Δun_t					-0.049*** (0.012)
$\Delta(w-p)_t$	0.376* (0.197)	0.316*** (0.078)	0.416** (0.146)	0.702*** (0.093)	0.137 (0.095)
$\Delta(w-p)_{t-1}$	-0.122** (0.056)			-0.115** (0.054)	
$\Delta(va_i-p)_{t-1}$				0.206*** (0.045)	0.112** (0.048)
Long-run coefficients					
$e+p^f-p$	0.623** (0.286)	0.289 (0.302)	-0.447 (0.305)	-0.584*** (0.191)	1.105 (0.745)
y	0.916** (0.360)	0.227 (0.367)	0.726** (0.285)	1.167*** (0.297)	
un					0.036 (0.116)
$w-p$	0.138 (0.374)	0.557 (0.382)	-0.177 (0.262)	0.569** (0.217)	0.093 (0.572)
Adjustment coefficient $(\tau_i - 1)$	-0.088 (0.017)	-0.090 (0.019)	-0.105 (0.028)	-0.077 (0.015)	-0.035 (0.015)
PSS t-test $(k=3)$	-5.28[^^^]	-4.76[^^^]	-3.73[^^]	-5.07[^^^]	-2.39[^]
R^2	0.559	0.313	0.478	0.671	0.632
Number of countries	20	20	20	20	20
Number of observation	540	558	575	567	514
RESET test	3.65[a]	0.04	0.27	3.05[a]	0.45
AR(1) test	1.73[d]	1.78[d]	1.08	0.11	0.50

See notes to Table G.2.

Table G.3 (A) Estimation Results by Sector, Real Value Added (baseline model, full sample)

Sectors	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
Dependent variable: $\Delta(\boldsymbol{va_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	0.525*** (0.131)	0.019 (0.240)	0.226*** (0.060)	-0.241 (0.143)	-0.250*** (0.068)
$\Delta(e + p^f - p)_{t-1}$	0.331** (0.132)		0.135*** (0.046)		-0.166** (0.071)
Δy_t	0.859** (0.363)	1.898*** (0.597)	1.313*** (0.161)	-0.040 (0.197)	1.848*** (0.221)
Δy_{t-1}				-0.578** (0.243)	0.477*** (0.163)
$\Delta(w - p)_t$	-0.170 (0.318)	-1.422*** (0.458)	0.048 (0.238)	-0.019 (0.186)	0.324 (0.292)
$\Delta(w - p)_{t-1}$		0.825** (0.301)			
$\Delta(va_i - p)_{t-1}$		0.079* (0.045)	0.069* (0.037)	-0.084** (0.037)	0.189*** (0.043)
Long-run coefficients					
$e + p^f - p$	0.644* (0.315)	1.545 (2.910)	1.229** (0.516)	-0.386 (0.637)	-1.271*** (0.282)
y	0.415 (0.545)	-0.781 (1.979)	0.237 (0.267)	0.703** (0.300)	1.663*** (0.147)
$w - p$	-0.669** (0.302)	2.769 (2.278)	0.316 (0.321)	-0.045 (0.374)	-0.254 (0.328)
Adjustment coefficient $(\tau_i - 1)$	-0.213 (0.034)	-0.058 (0.019)	-0.093 (0.031)	-0.149 (0.026)	-0.167 (0.025)
PSS t-test $(k = 3)$	-6.30^^^	-3.00^^	-2.97^^	-5.82^^^	-6.65^^^
R^2	0.364	0.451	0.675	0.260	0.618
Number of countries	20	18	20	20	20
Number of observation	608	542	609	608	607
RESET test	1.16	14.46[c]	0.40	37.17[c]	9.92[b]
AR(1) test	-1.36	-0.10	1.04	-0.70	-0.81

See notes to Table G.2.

Table G.3 (A) Estimation Results by Sector, Real Value Added (baseline model, full sample) (continued)

Sectors	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*
Dependent variable: $\Delta(\boldsymbol{va_i - p})_t$				
Short-run coefficients				
$\Delta(e + p^f - p)_t$	-0.014 (0.069)	0.035 (0.053)	0.020 (0.034)	-0.063** (0.028)
Δy_t	1.292*** (0.133)	0.406** (0.144)	0.612*** (0.114)	0.131** (0.049)
$\Delta(w - p)_t$	0.385** (0.160)	0.232** (0.091)	0.327** (0.153)	0.735*** (0.081)
$\Delta(w - p)_{t-1}$	-0.125** (0.056)			-0.147** (0.062)
$\Delta(va_i - p)_{t-1}$		0.105* (0.058)	0.095*** (0.027)	0.221*** (0.043)
Long-run coefficients				
$e + p^f - p$	0.372 (0.281)	0.133 (0.252)	-0.236 (0.304)	-0.583*** (0.171)
y	0.980*** (0.174)	0.558*** (0.181)	1.386*** (0.419)	0.911*** (0.207)
$w - p$	0.067 (0.293)	0.358 (0.267)	-0.230 (0.220)	0.667*** (0.159)
Adjustment coefficient $(\tau_i - 1)$	-0.102 (0.023)	-0.108 (0.024)	-0.101 (0.028)	-0.081 (0.020)
PSS t-test $(k = 3)$	-4.49^^^	-4.53^^^	-3.56^^	-4.15^^^
R^2	0.525	0.320	0.442	0.661
Number of countries	20	20	20	20
Number of observation	606	608	608	606
RESET test	5.87[b]	0.03	1.26	1.10
AR(1) test	0.68	-0.79	0.19	0.33

See notes to Table G.2.

Table G.3 (B) Estimation Results by Multi-Sector Aggregate, Real Value Added (baseline model, full sample)

Sectors	*Non-agriculture business sector*	*Business sector services*	*Total services*	*Total Economy*
Dependent variable $\Delta(\boldsymbol{va_i - p})_t$				
Short-run coefficients				
$\Delta\left(e + p^f - p\right)_t$	0.006 (0.029)	0.032 (0.026)	-0.006 (0.018)	0.056* (0.028)
Δy_t	1.311*** (0.033)	0.795*** (0.093)	0.585*** (0.059)	
Δun_t				-0.048*** (0.011)
$\Delta(w - p)_t$	-0.263* (0.128)	0.295** (0.123)	0.464*** (0.104)	0.152 (0.091)
$\Delta(va_i - p)_{t-1}$	0.057** (0.026)			0.092* (0.046)
Long-run coefficients				
$e + p^f - p$	0.110 (0.120)	0.200 (0.250)	-0.216 (0.206)	3.473 (3.371)
y	1.027*** (0.142)	1.360 (0.403)	1.425 (0.285)	
un				0.069 (0.294)
$w - p$	0.008 (0.089)	-0.289 (0.136)	0.297 (0.194)	-0.194 (1.267)
Adjustment coefficient $(\tau_i - 1)$	-0.124 (0.040)	-0.060 (0.028)	-0.050 (0.030)	-0.013 (0.009)
PSS t-test $(k = 2)$	-3.10^^	-2.13^	-1.67^	-1.51^
R^2	0.882	0.582	0.711	0.608
Number of countries	20	20	20	20
Number of observations	467	624	624	545
RESET test	2.26	0.64	0.00	0.11
AR(1) test	1.55	-1.64	-0.89	0.68

See notes to Table 2.2 (A). *un* denotes the natural logarithm of the unemployment rate.

Table G.4 Estimation Results by Manufacturing Subsector, Real Value Added (baseline model, full sample)

Subsectors	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
Dependent variable: $\Delta(\boldsymbol{va_i} - \boldsymbol{p})_{\boldsymbol{t}}$					
Short-run coefficients					
$\Delta\left(e + p^f - p\right)_t$	-0.014 (0.084)	0.136 (0.113)	0.120 (0.138)	0.248** (0.104)	0.486*** (0.126)
$\Delta(e + p^f - p)_{t-1}$		0.291*** (0.087)			
Δy_t	0.161 (0.169)	1.164*** (0.210)	2.251*** (0.289)	1.573*** (0.309)	1.083*** (0.295)
$\Delta(w-p)_t$	0.198 (0.133)	0.235 (0.164)	-0.026 (0.412)	-0.210 (0.306)	-0.105 (0.303)
$\Delta(w-p)_{t-1}$				-0.289** (0.119)	
$\Delta(va_i - p)_{t-1}$					-0.089* (0.045)
Long-run coefficients					
$e + p^f - p$	0.495 (0.423)	2.940** (1.389)	0.145 (0.611)	0.183 (0.279)	2.294*** (0.688)
y	0.748** (0.325)	-1.450 (0.859)	0.298 (0.402)	0.924*** (0.262)	0.402 (0.444)
$w-p$	-0.052 (0.439)	-0.913 (0.715)	0.109 (0.792)	-0.277 (0.203)	0.879 (0.644)
Adjustment coefficient $(\tau_i - 1)$	-0.109 (0.019)	-0.059 (0.016)	-0.136 (0.035)	-0.204 (0.039)	-0.128 (0.030)
PSS t-test $(k=3)$	-5.77^^^	-3.68^^	-3.91^^^	-5.22^^^	-4.29^^^
R^2	0.232	0.468	0.417	0.534	0.344
Number of countries	20	20	20	20	20
Number of observation	622	608	622	604	610
RESET test	9.24[c]	177	0.00	2.56	3.13[a]
AR(1) test	-0.55	1.19	0.44	1.20	-0.54

See notes to Table 2.2 (A).

Table G.4 Estimation Results by Manufacturing Subsector, Real Value Added

(baseline model, full sample) (continued)

Subsectors	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
Dependent variable: $\Delta(\boldsymbol{va_i - p})_t$					
Short-run coefficients					
$\Delta(e + p^f - p)_t$	-0.077 (0.095)	0.539*** (0.106)	0.189** (0.089)	-0.245 (0.211)	-0.106 (0.158)
$\Delta(e + p^f - p)_{t-1}$				0.379** (0.144)	
Δy_t	2.087*** (0.225)	1.782*** (0.239)	1.505*** (0.154)	1.404*** (0.363)	1.574*** (0.223)
$\Delta(w - p)_t$	0.131 (0.258)	-0.024 (0.283)	0.026 (0.302)	0.597*** (0.204)	0.395* (0.221)
$\Delta(va_i - p)_{t-1}$	0.150*** (0.037)		0.125** (0.055)		0.106** (0.040)
Long-run coefficients					
$e + p^f - p$	0.013 (0.291)	1.843** (0.712)	1.715* (1.952)	-0.910 (1.495)	0.396 (0.909)
y	0.458 (0.328)	0.168 (0.340)	-0.188 (0.482)	0.011 (0.490)	0.522 (0.786)
$w - p$	-0.057 (0.251)	0.577 (0.426)	0.968 (0.657)	-0.372 (0.681)	0.192 (0.657)
Adjustment coefficient $(\tau_i - 1)$	-0.176 (0.022)	-0.099 (0.030)	-0.084 (0.027)	-0.104 (0.022)	-0.099 (0.030)
PSS t-test $(k = 3)$	-8.01^^^	-3.32^^	-3.11^^	-4.80^^^	-3.34^^
R^2	0.535	0.590	0.456	0.254	0.330
Number of countries	20	20	20	20	20
Number of observation	610	622	610	608	610
RESET test	2.87	4.21[a]	0.02	0.05	0.66
AR(1) test	-0.93	0.41	-0.01	0.72	-0.46

See notes to Table 2.2 (A).

Table G.5 Adjusted Exchange Rate Coefficients

Dependent variable	Exchange rate parameter	*Agriculture, hunting, forestry and fishing*	*Mining and quarrying*	*Manufacturing*	*Electricity, gas and water supply*	*Construction*
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$ **(reduced sample)**	$\Delta(e + p^f - p)_t$	0.422***	0.046	0.237***	-0.117	-0.256***
	$e + p^f - p$	0.619***	1.369	0.792**	-0.207	-0.754***
Change in relative price	$\Delta(e + p^f - p)_t$	0.417	0.237	0.015	0.202	-0.065
	$e + p^f - p$	0.022	1.439	-0.775	0.648	-0.320
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$ **(full sample)**	$\Delta(e + p^f - p)_t$	0.542***	0.012	0.229***	-0.153	-0.263***
	$e + p^f - p$	0.408*	0.978	0.778**	-0.244	-0.805***

Dependent variable	Exchange rate parameter	*Wholesale and retail trade; Restaurants and hotels*	*Transport, storage and communication*	*Finance, insurance, real estate and business services*	*Community social and personal services*
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$ **(reduced sample)**	$\Delta(e + p^f - p)_t$	-0.034	0.022	0.015	-0.044**
	$e + p^f - p$	0.394***	0.183	-0.283	-0.370***
Change in relative price	$\Delta(e + p^f - p)_t$	-0.020	-0.003	0.027	-0.024
	$e + p^f - p$	0.062	0.308	-0.389	0.065
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$ **(full sample)**	$\Delta(e + p^f - p)_t$	-0.009	0.022	0.013	-0.040**
	$e + p^f - p$	0.235	0.084	-0.149	-0.369***

Dependent variable	Exchange rate parameter	*Non-agriculture business sector*	*Business sector services*	*Total services*	*Total*
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$ **(reduced sample)**	$\Delta(e + p^f - p)_t$				0.037*
	$e + p^f - p$				0.699
Change in relative price	$\Delta(e + p^f - p)_t$				0.003
	$e + p^f - p$				0.121
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$ **(full sample)**	$\Delta(e + p^f - p)_t$	0.004	0.020	-0.004	0.035*
	$e + p^f - p$	0.070	0.127	-0.137	2.198

Dependent variable	Exchange rate parameter	*Food products, beverages and tobacco*	*Textiles, textile products, leather and footwear*	*Wood and products of wood and cork*	*Pulp, paper, paper products, printing and publishing*	*Chemical, rubber, plastics and fuel products*
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$ **(full sample)**	$\Delta(e + p^f - p)_t$	-0.009	0.270***	0.076	0.157**	0.308***
	$e + p^f - p$	0.313	1.861**	0.092	0.116	1.452***

Dependent variable	Exchange rate parameter	*Other non-metallic mineral products*	*Basic metals and fabricated metal products*	*Machinery and equipment*	*Transport equipment*	*Manufacturing nec.; Recycling*
$\Delta(\boldsymbol{va_i} - \boldsymbol{p})_t$ **(full sample)**	$\Delta(e + p^f - p)_t$	-0.049	0.341***	0.120**	0.059**	-0.067
	$e + p^f - p$	0.008	1.167**	1.086*	-0.576	0.251

Note: (1) To obtain the effects of the real exchange rate itself on real value added, the original exchange rate coefficients are multiplied by the average trade share 0.633.

(2) Changes in relative price are calculated for each sector as the difference between exchange rate-induced changes in real value added and in value added volumes.

Appendix H. Data Sources

VA_i/P: real value added of sector i. It is calculated as sector i's value added divided by the GDP deflator. Sectoral value added data is obtained from the variable Value added at current prices (VALU) in the OECD STAN Database. Value added, volumes (VALK) is obtained from the same database. According to the definition of the STAN Database, value added is calculated as the difference between Production (Gross Output) (PROD) and Intermediate inputs (INTI), both measured at current prices. Value added at current prices is comprised of Labor costs (Labor compensation of employees, LABR), Consumption of fixed capital (CFCC), Other taxes less subsidies, and Net operating surplus and mixed income (NOPS). Value added for Total economy in a particular year is equal to the nominal GDP in that year.

W/P: the real wage. It is calculated as a ratio of the real labor compensation of the total economy (i.e., the nominal labor compensation divided by the GDP deflator) to total employment. Data for labor compensation and employment are available in the OECD STAN Database for Industrial Analysis.

W_i/P: the real wage of sector i. It is calculated as sector i's average labor compensation (i.e., the ratio of sector i's labor compensation to its employment) divided by the GDP deflator. Sectoral labor compensation data is available in the OECD STAN Database. According to the definition of the STAN Database, Labor costs or Compensation of employees is comprised of wages and salaries of employees paid by producers as well as supplements such as contributions to social security, private pensions, health insurance, life insurance and similar schemes.

$\prod_i$: the sectoral real profits of sector i, is calculated as (value added of sector i – labor compensation of sector i) / the general price level of country *c*. The data for sectoral value added and labor compensation are obtained from the OECD STAN Database for Industrial Analysis, captured respectively by the variables Value added at current prices (VALU) and Labor compensation of employees (LABR).

P : the general price level of the domestic country and is represented by the GDP deflator at market prices from OECD Economic Outlook Statistics and Projections database.

EP^f/P : the real exchange rate, the data of which come from the Real Effective Exchange Rate (CPI based) under the category of Main Economic Indicators in the OECD database, weighted by the mean of the share of the sum of aggregate imports and exports in domestic GDP for each sample country during the period 1970-2008. Data for imports, exports and nominal GDP are respectively obtained from the series Imports and Exports of goods and services and Gross domestic product (expenditure approach, at current prices) under the category of National Accounts and Historical Statistics of the OECD database.

Y : domestic real GDP (expenditure approach[62], in millions of domestic currency, OECD base year = 2000) obtained from the National Accounts and Historical Statistics category of the OECD database.

Employment: sectoral employment data is obtained from Total employment (EMPN), number engaged of the OECD STAN Database for Industrial Analysis.

Sectoral export orientation and import penetration: export orientation is calculated as sectoral exports divided by sectoral value added. Import penetration is calculated as sectoral imports divided by sectoral value added plus imports less exports. Data for sectoral imports and exports are obtained from the variables Imports of goods at current prices (IMPO) and Exports of goods at current prices (EXPO) in the OECD STAN Database for Industrial Analysis.

Exchange rate volatility: measured by the weighted standard deviation of the quarterly difference in the log of the nominal effective exchange rate, the data of which are obtained from the Nominal effective exchange rate (chain-linked, overall weights) under

[62] The output measure of GDP (i.e., output approach), which is obtained by combining value added of all industries should be used in this study. However, since the three measures of GDP (i.e., output approach, expenditure approach, and income approach) typically do not differ very much from one another, and total exports and imports data are only available under the expenditure meausre of GDP, to keep consistency, the expenditure measure is adopted.

the category of Interest Rates, Exchange Rates and Monetary Aggregates in the OECD Economic Outlook Statistics and Projections database.

r : the long-term interest rate on government bonds, the data for which can be obtained from the OECD Economic Outlook Statistics and Projections database. The real long-term interest rate is used in the regression, it is calculated as the difference between the nominal long-term interest rate and the lagged inflation rate.

Unemployment rate: Rate of unemployment as % of civilian labor forces from the OECD Economic Indicators Database.