Aggregate Investment Expenditures on Traded and Nontraded Goods*

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Abstract

This paper shows that aggregate investment expenditure shares on traded and nontraded goods are very similar in rich and poor countries. Furthermore, the two expenditure shares have remained close to constant over time, with the average nontraded expenditure share varying between 0.54-0.60 over the 1960-2002 period. Combined with the fact that the relative price of nontraded goods correlates positively with income and exhibits large differences across space and time, our findings suggest that investment can be modeled using the Cobb-Douglas aggregator. The results of this paper offer a new restriction for the two-sector growth model. We apply the restriction to a study by Hsieh and Klenow (2003), which argues that differences in relative productivity between traded and nontraded sectors, i.e., the Balassa-Samuelson effect, is the main cause of higher PPP-adjusted investment rates in rich countries. With the restriction imposed on the model, only around 25 percent of the differences in PPP-adjusted investment rates between rich and poor counties can be attributed to the Balassa-Samuelson effect.

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1 Introduction

Models with traded and nontraded goods are widely used in macroeconomics. A common practice in the literature is to assume that only traded goods can be transformed into investment goods, although an assumption that only nontraded or both traded and nontraded goods are used in the capital formation process has also been used.[1] Model results are sensitive to the assumption used.

This paper provides a systematic empirical examination of the role played by traded and nontraded goods in the capital accumulation process. We find that around 60 percent of aggregate investment expenditures are spend on nontraded goods. Aggregate investment expenditure shares on traded and nontraded goods are very similar in rich and poor countries around the world. Moreover, the two investment expenditure shares have remained close to constant over the last 50 years.

To reach such conclusions, this paper examines extensive empirical evidence – up to 115 countries for cross-section data and up to 53 years for annual time-series data. The results suggest no significant systematic differences in investment expenditure shares between countries with widely different income levels. The correlation between the investment expenditure share on nontraded goods and per capita income is between -0.30 and 0.30. We also find no significant differences in investment expenditure shares between different regions of the world, such as Africa, South-East Asia, Europe or Latin America.

Nontraded expenditure shares in most of the sample countries show no noticeable time trends during the second half of the 20th century. For the OECD countries, a pooled linear time trend in the nontraded goods' expenditure share has a 95 percent confidence interval of $(-0.015, -0.010)$ *per decade*. Cross-section averages are also close to trendless. Over the 1960-2002 period, the average nontraded expenditure share has decreased from 0.60 to around 0.57.

One of the most consistent related empirical findings in the macroeconomic literature is that the relative price of nontraded goods in terms of traded goods exhibits a strong positive correlation with income in cross-section as well as time-series data.[2] Price data for traded and nontraded goods in investments offers no exception to this empirical regularity. In rich countries, such as the U.S., the relative price of nontraded goods in

[1] For examples of models with only traded goods in investments see Rebelo and Vegh (1995), Obstfeld and Rogoff (1996), Mendoza and Uribe (2000), Uribe (2002). The assumption of only nontraded goods in investments is used, for example, in van Wincoop (1993). For a model with both traded and nontraded goods in investments see, for example, Stockman and Tesar (1995), Laxton and Pesenti (2003).

[2] See, among others, Balassa (1964), Samuelson (1964), Kravis et al. (1982) and De Gregorio et al. (1994).

investments is 3-4 times higher than in poor countries, such as Kenya, Morocco and Egypt. Similarly, the relative price of nontraded goods in investments has doubled in OECD countries over the last 30 years.[3] Furthermore, there is evidence that the variation in relative prices in cross-section and time-series data would be even larger after properly adjusting for improvements in quality.[4]

Combined with the large variation in relative prices, our results suggest that at the level of aggregate economy investment process can be modeled using a unitary elasticity of substitution between traded and nontraded goods, i.e., the Cobb-Douglas case. Importantly, our findings are based entirely on current price data and are therefore immune to problems associated with the measurement of changes in relative prices for the two investment components.

The results of this paper are applicable not only to small open economy models with traded and nontraded goods, but also to closed economy models differentiating between equipment (or durable goods) and structures (or plants) in investments. This is the case since, as shown in the paper, 90 percent of the aggregate investment expenditures are spent on acquiring output from only two sectors of economic activity – equipment from the manufacturing sector and structures from the construction sector. The former is a traded and the latter a nontraded good.

To our knowledge, no previous research has extensively examined the question addressed in this paper. De Long and Summers (1991) and, more recently, Burstein et al. (2004) point out that investments have a very significant nontradable component. Drawing on evidence from 19 medium and high income countries, Burstein et al. (2004) also report a strong negative correlation (-0.69) between investment expenditures on nontraded goods and real per capita income. The considerably larger dataset of our paper does not support this finding. For the particular country-year observations, used by Burstein et al. (2004), our data also exhibit a negative correlation between the nontraded expenditure share and real per capita income. However, when the whole dataset is considered, the correlation is small and positive.

Our results agree with findings in Whelan (2003), who argues that the investment expenditure share on equipment in the U.S. National Income and Products Accounts data exhibits no significant trend over the past 50 years. He finds that over 1960-1999, durable goods accounted for 47 percent of the investment expenditures in the U.S.

The findings of this paper fit well with several already established empirical regulari-

[3] Data from 1996 benchmark for Penn World Tables 6.1 (see Heston et al. (2002)) and OECD detailed national accounts (see OECD (2004)).

[4] See Gordon (1990) and Navaretti et al. (2000).

ties in the growth literature. First, it has repeatedly been reported that investment rates, calculated in domestic prices, have little correlation with real per capita income.[5] Eaton and Kortum (2001) find that the same is true for equipment investment rates, calculated in domestic prices.[6] Combined with either of the two findings, our results would imply the other finding. Second, combined with the higher relative price of nontraded goods in rich countries, the empirical results of our paper imply that equipment intensity of investments should increase with income. De Long and Summers (1991, 1993) find this to be the case.

Our results provide empirical support for two-sector growth models in which aggregate investment expenditure shares on traded and nontraded goods (or equipment and structures) are non-zero and constant over time. There are, in fact, several models in the literature that satisfy this restriction, although the empirical motivation behind the modeling choice has been missing.[7]

In the second part of the paper, we set up a two-sector small open economy growth model with traded and nontraded goods in investments to address one of the unsettled questions in the growth literature – what causes the large differences in *international price* investment rates between rich and poor countries? Among other explanations, Hsieh and Klenow (2003) have identified the Balassa-Samuelson effect, i.e. differences in relative productivity between traded and nontraded sectors across countries, as a potential source of differences in investment rates. Using the two-sector growth model we show that, when the composition of traded and nontraded goods in investments is correctly accounted for, only around 25 percent of the differences in *international price* investment rates between rich and poor countries can be attributed to differences in relative productivity between traded and nontraded sectors. The driving force behind this result is the empirical finding that the composition of investments and consumption between traded and nontraded goods is much more similar than what is commonly assumed in the literature.

The structure of the rest of the paper is as follows. In Section 2, we examine how much of the aggregate investment expenditures are spent on the output of different sectors of economic activity. This section also presents the data sources and discusses several data related issues. Section 3 presents empirical findings about the nontraded expendi-

[5] See, among others, Parente and Prescott (2000, p 39-40) and Restuccia and Urrutia (2001).

[6] In the rest of this paper, investment rates, calculated in domestic prices, will be called *domestic price* investment rates, while investment rates, calculated in common prices for all countries, will be called *international price* investment rates.

[7] See, for example, Brock and Turnovsky (1994), Fernandez de Cordoba and Kehoe (2000) for open economy models and Greenwood et al. (1997) and Whelan (2003) for closed economy models that comply with this empirical regularity.

ture shares in both time-series and cross-section data. Section 4 presents a small open economy two-sector growth model with traded and nontraded goods in consumption and investments. The model is solved both analytically and numerically and its implications for investment rate differences between rich and poor countries are examined. Section 5 concludes.

2 The data

2.1 Structure of aggregate investment expenditures

We start by looking at the distribution of investment expenditures between the output of different sectors of economic activity. The most appropriate data source for this purpose is input-output tables and we use data from the OECD input-output database (see OECD (2000a, 2000b)).

Table 1 presents investment spending for 10 OECD countries during 1970-1990. The expenditure pattern reveals that around 90 percent of the investment expenditures are spent on the output of two sectors of economic activity: manufacturing and construction. Manufacturing goods in investments, e.g. machinery and transportation equipment, are traded goods, while the output of the construction sector, e.g. residential and nonresidential buildings, is nontraded. Measures of tradedness of sectoral output usually put these two sectors at the opposite extremes of the spectrum.[8] The weight of manufacturing and construction in investment expenditures in Table 1 is stable across time and sample countries, varying between 0.85-0.95.[9]

From the remaining 10 percent of aggregate investment expenditures, 4/5 are spent on the output of two other sectors: retail/wholesale trade and real estate/business services sectors, both of which are nontraded services. This leaves two percent of the investment expenditures, which are spent on the output of other sectors, such as financial intermediation, agriculture, transport and communications.

The structure of investment expenditures in Table 1 is very similar to that reported in Burstein et al. (2004). Their sample refers to the 1990-1998 period and includes 18 observations from input-output tables for OECD countries as well as Argentina and Chile. Burstein et al. (2004) find that the construction sector accounts for 51 percent of the investment expenditures and distribution and real estate services for 8 percent.

[8] See e.g. De Grigorio et al. (1994).

[9] The Netherlands stand out from the rest of the sample, with weights for manufacturing and construction varying within the 0.83-0.86 range.

While input-output data on investment expenditures might be sufficient to draw conclusions about the relative importance of traded and nontraded goods in aggregate investments, the coverage is clearly too limited to say anything convincing about the other questions we set out to answer in this paper. An alternative data source is detailed gross fixed capital formation (GFCF) data from national accounts (NA). This data offer a considerably larger sample for our investigation. However, they also incorrectly assign some of the investment expenditures on nontraded goods as expenditures on traded goods. Investment expenditures on the output of manufacturing and construction sectors in the NA data are reported separately, so that 90 percent of the investment expenditures can be correctly accounted for as traded or nontraded. At the same time, retail/wholesale trade and real estate/business services, both of which are nontraded, are not accounted for separately. Hence, such expenditures are assigned to expenditures on either construction or manufacturing output.

Ignoring the 2 percent of investment expenditures spent on output of other traded and nontraded sectors, we conclude that NA data can account for investment expenditures on nontraded goods with an error in the range of -0.08 to 0.00. The maximum error would apply if all retail/wholesale trade and real estate/business services were assigned to the output from the manufacturing sector. If, on the other hand, these services are assigned to the expenditures on the output of the construction sector, NA data would contain no error. In this case, traded and nontraded expenditures are correctly accounted for.

Clearly, the actual size of the error is somewhere in between these two extremes. Comparing investment expenditure data from input-output tables and NA, an estimate of the size of the error can be obtained. When data in Table 1 are compared with their counterpart from NA, NA data are found to underestimate the share of investment expenditures on nontraded goods by 0.040-0.059. The size of the error appears to be stable during the 30 year period for which input-output tables are available.[10]

2.2 Data sources

In view of the considerably larger coverage of the NA data and the small size of the error, the rest of the paper builds on evidence from the detailed GFCF data of NA. Three distinct datasets are used:

1. Annual GFCF data from the United Nations (UN) detailed NA statistics. This dataset covers the 1950-1997 period. The number of countries included in the

[10] Details of the estimation of the error are presented in Appendix A. This Appendix also considers the role of traded intermediate inputs in the production of structures and the role of nontraded intermediate inputs in the production of equipment.

sample gradually increases from 9 in 1950 to 30 in 1960, 71 in 1970, 80 in 1980 and thereafter gradually decreases to 74 in 1990 and 21 in 1997. In total, there are 2515 observations. In this dataset, GFCF data are divided into (i) residential buildings, (ii) non-residential buildings, (iii) other construction and land development and (iv) other. For the purpose of our investigation, we define residential, non-residential buildings, other construction and land development as nontraded investment goods and 'other' products as traded investment goods.

2. NA data for 1970, 1975, 1980, 1985 and 1996 benchmarks in Penn World Tables (PWT). Details of these data are available in Summers et al. (1995) and Heston et al. (2002). This dataset is further complemented with data for 1987 from Nehru-Dhareshwar (1993). The sample size for different years gradually increases from 16 countries in 1970 to 34 in 1975, 60 in 1980, 65 in 1985, 42 in 1987 and 115 in 1996. In 1996, PWT benchmark GFCF data are divided into (i) construction and (ii) machinery and equipment. In this case, we define construction as nontraded input and machinery and equipment as traded input. The same division is also available for the 1987 data. Benchmark data for 1970, 1975, 1980 and 1985 report up to 20 subcategories of GFCF, which we divide into traded and nontraded sectors by defining all equipment and machinery related subcategories as traded and all construction related subcategories as nontraded.

3. OECD annual detailed NA data, which contain GFCF data for a period from 1970-1995 until 2002 depending on a country. Detailed investment data from 1970 are available for 9 countries.[11] For 12 additional countries, data become available starting with some year between 1970 and 1995. For three of the sample countries, data for 2002 were not available. Disaggregation of GFCF data from OECD detailed NA distinguishes between six types of investment inputs: (i) products of agriculture, forestry, fishing and aquaculture, (ii) metal products and machinery, (iii) transport equipment, (iv) dwellings, (v) other buildings or structures and (iv) other products. For our purpose, we define (i)-(iii) as traded inputs and (iv)-(v) as nontraded.

   The treatment of 'other products' requires a more careful consideration. The main components of this subgroup of investment expenditures are intangible fixed assets (e.g., mineral exploration, computer software, entertainment, literary or artistic originals) and costs associated with the transfer of ownership of non-produced as-

[11] Also includes New Zealand with data coverage starting from 1971.

sets. Although most of the items in the subgroup are nontraded, some types of computer software, for example, should be treated as traded services. Unfortunately, no further breakdown of the 'other products' category is available. For the purpose of our investigation, we therefore exclude 'other products' from GFCF data. On average, this amounts to excluding 3 percent of the GFCF in 1970 and 10 percent in 2002.

Although all three datasets use NA statistics, there are good reasons for examining each of them separately. The UN dataset contains the largest number of countries and covers the whole post WWII period. Data for this dataset are collected using standardized NA statistics reports provided to the UN statistics office by the national statistical offices of its member states.

The benchmark data for PWT offer the largest cross-section comparison of 115 countries for 1996. GFCF data in PWT are more detailed than in the UN dataset and compiled as part of a worldwide IPC project. Data from Nehru and Dhareshwar (1993) should, in principle, be treated as a separate cross-section dataset for 1987, compiled by the authors using various sources (see Nehru and Dhareshwar (1993) for details).

The distinguishing feature of the OECD dataset is that its data are compiled using SNA 93 definitions. This is the reason why the GFCF subgroup 'other products' in the OECD dataset is not available as a separate subgroup in the other datasets. In addition, the OECD dataset is the only one containing GFCF data for the 1998-2002 period.

3 Empirical evidence on investment expenditure shares

This section first presents empirical evidence from time-series data and then considers the evidence from cross-section comparisons. At the end of the section, we discuss the compatibility of our findings with several already established empirical regularities in the growth literature.

3.1 Time-series data

Time series results are based on annual investment expenditure data from the OECD NA and the UN NA. Starting with the OECD dataset, Table 2 summarizes investment expenditure shares on nontraded goods for twenty-one OECD countries. All country-year observations of this variable are between 0.40-0.76. The dashed line in Figure 1 depicts the average yearly expenditure share on nontraded goods in the OECD data for the nine countries with full 1970-2002 coverage.[12] Between 1970 and 2002, the average expenditure share decreased by a mere 0.01.

Figure 2 depicts the annual time series data for the six largest economies in the OECD sample. We see that in each country, the nontraded expenditure share is quite stable over time and differences across countries are small but persistent. For two of the countries in Figure 2, the US and France, there is a clear time trend in the expenditure shares, although its slope is small.

Data for the six largest economies are representative of the rest of the sample countries. Panel 1 in Table 4 shows results of a simple linear time trend regression for sample countries with at least 30 years of data. Time trends in Table 4 are expressed as a change in aggregate investment expenditures on nontraded goods over a decade. For five countries out of nine, the time trends are significantly different from zero at a 5 percent confidence level. At the same time, with the exception of Denmark, the point estimate of the time trends in all countries is between -0.03 to 0.03 per decade. Panel 1 in Table 5 shows results for a pooled regression containing the same nine countries and a panel regression with country dummies. In either case, the results suggest that there is a small, negative and significant time trend in the investment expenditure data.

Between some of the countries in the OECD dataset, there are significant differences in investment expenditures on traded and nontraded goods. From Table 1, the highest average nontraded expenditure share for a country (Canada 0.689) is 0.226 higher than the lowest average expenditure share (Sweden 0.463). The pattern of high and low expenditure shares shows persistence over time. To measure this persistence, we divide the OECD dataset into three equal eleven-year periods and calculate the correlation of nontraded expenditure shares between any two periods. Between 1970-80 and 1981-91, the expenditure share correlation is 0.59. For 1970-80 and 1992-2002, the correlation is 0.56. Between 1981-91 and 1992-2002, the correlation is 0.81.

Data from the UN NA provide further support for the observations made with the OECD data (see Table 3). The UN dataset includes at least one observation for 113 countries and the range of nontraded expenditure shares is generally wider.[13] However, 95 percent of all country-year observations for nontraded expenditure shares are in the 0.33-0.79 range and 90 percent are in the 0.39-0.75 range.

The sample average nontraded expenditure share in the UN NA data, also depicted in Figure 1, is stable over time. While the share decreases by 0.08 from 0.68 to 0.60 during

[12] These countries are: Denmark, Finland, Germany, Italy, the Netherlands, United States, Norway, United Kingdom and also New Zealand with 1971-2001 coverage.

[13] At one extreme, in Kyrgyzstan the nontraded expenditure share is 0.99 in 1996 and, at the other extreme, in Tanzania the share is 0.20 in 1989.

the first 10 years of the sample (1950-1959), the share fluctuates within the 0.54-0.60 range with only a slight downward trend during the subsequent 37 years.

Panels 2 and 3 in Table 4 present time trend regressions for OECD and non-OECD countries. With few exceptions, the results for both sets of countries are very similar to what we observed in Panel 1 of Table 4. This is further confirmed by the results in Panel 2 of Table 5. Point estimates for time trends in OECD countries in Table 5 range between -0.012 to -0.014 per decade. As can be expected, non-OECD countries exhibit more variation in the time trends. Also, in non-OECD countries, time trends in pooled and panel regressions of Table 5 are larger than in OECD countries, ranging between -0.016 to -0.020 per decade.

Average nontraded expenditure shares across countries in the UN data range from 0.34 for Saint Kitts and Nevis to 0.97 for Kyrgyztan. Large differences in nontraded expenditure shares are present not only at the extremes. Thus, in the sample on 113 countries, the 10th smallest average nontraded expenditure share is 0.429 (Equatorial Guinea), while the 10th largest is 0.719 (Iceland). Table 6 shows the persistent pattern of high and low nontraded expenditures over time in the UN dataset divided into five periods: 1950-59, 1960-69, 1970-79, 1980-89 and 1990-97. Correlations of the expenditure shares between any two subsequent decades are in the 0.64-0.86 range, with a smaller, but still positive, correlation between any other two decades.

To summarize the empirical evidence from time series data, several points need to be stressed. First, both traded and nontraded goods are important ingredients in investments. Furthermore, aggregate investment expenditures on nontraded goods often exceed the expenditures on traded goods.

Second, at a yearly frequency, nontraded expenditure shares of individual countries show little variation and no notable time trends during the second half of the 20th century. As a result, sample averages also exhibit no economically significant time trend. A simple linear trend for the average nontraded expenditure share in the OECD and UN detailed NA data suggests that over the 1960-2002 period (43 years), the share has decreased from 0.60 to around 0.57. This finding is particularly remarkable, given the large changes in relative prices of traded and nontraded goods in investments since 1960s.

Third, there are sizable and persistent differences in expenditure shares between some of the sample countries.

3.2 Cross-section data

Equally interesting is the cross-section evidence about differences in nontraded expenditure shares across different country characteristics, most importantly the level of income. Table 7 presents the cross-section results from the UN dataset for each year between 1950 and 1997. The mean of the sample, presented in Figure 1, was already discussed with the time series evidence. The fourth column of Table 7 shows the correlation between the nontraded expenditure share and PPP adjusted income per capita across countries.[14] In all the sample years, the correlation is within the -0.31 to 0.32 range. Furthermore, with the exception of the six years 1950-53 and 1995-1996, the correlation is within the -0.03 to 0.32 range. Thus, in the UN dataset, there is a small and positive correlation between expenditure shares and per capita income in all but a few sample years. The average correlation across 1950-97 is 0.10.

Cross section results from the PWT dataset, presented in Table 8, show a very similar picture. For all six sample years, the correlation is positive and in five cases out of six, the correlation is between 0.04 and 0.31. To illustrate the correlation between income and expenditure shares, Figure 3 plots the two data series for the largest cross-section sample from the PWT dataset. Figures 4-7 present the same data from the UN dataset for the years 1960, 1970, 1980 and 1990.

Next, we use the largest PWT benchmark dataset for 1996 to investigate the differences in the nontraded expenditure shares across different regions of the world. Table 9 shows that, once more, there is very little variation. The average coefficients for eight different country groups range between 0.51 and 0.66.

The only notable exception in the PWT 1996 benchmark dataset is Africa, where the coefficient is much lower than in other regions. For 1996, the nontraded expenditure share in each of the 22 African countries is below the sample average of 0.51. To find out more about African countries, Table 9 also includes the average coefficients for Africa in 1985 and 1980 PWT benchmark datasets. The 1996 results for Africa appear to be an exception. Since Africa represents a sizable country group, this can explain why the average coefficient in the whole PWT 1996 benchmark dataset (see Table 8) is lower than in previous years. The last column of Table 9 reports correlations with income for each of the country groups. For five groups out of eight, the correlation is in the -0.02 to 0.32 range.

[14] Several measures of economic activity were considered, including real GDP per capita in constant international prices, GDP per capita in current prices and real GDP per worker in constant international prices. The correlations between investment expenditure share and different measures of income are very similar.

Table 10 presents the UN data separately for four country groups: Africa, Europe, Latin America and South East Asia. Years before 1960 have been excluded from the table, since the number of countries did not exceed two in any of the groups. With few exceptions, the average nontraded expenditure share in any of the groups does not deviate from the total sample average by more than 0.05.[15] This result is illustrated in Figure 8. Note that, in contrast to PWT 1996 benchmark data, expenditure shares in African countries during 1990-95 are only slightly below the sample average and for the sample of three African countries in 1996, it is above the sample average.

Table 11 summarizes the cross-section results for OECD countries in the OECD dataset. The average expenditure share for the sample of twenty-one developed countries is very similar to the average numbers in the UN and PWT datasets. During the 1970-1990 period, the correlation between income and nontraded expenditure shares in the OECD country group is systematically higher than the correlation observed for the whole sample in the UN data. This finding is confirmed with the correlation coefficients for European countries in Table 10. During the 1990s, the correlation is close to the total sample correlation in the UN dataset.

The cross-section results are not affected, if the differences in the size of population across countries are taken into account. The average correlation between the size of the population and the expenditure shares in the UN dataset is 0.01, with correlations for different years varying in the -0.20 to 0.10 range. One observation that does stand out in all cross-section comparisons is that countries with lower per capita income exhibit more variation in nontraded expenditure shares (e.g. see Figures 3-7). The same is also true for the time series data (see Table 4).

Overall, cross-section evidence indicates that nontraded expenditure shares increase systematically with the level of per capita income. However, the magnitude of the increase is small. For example, the linear trend fitted into Figures 3-7 suggests that a country with a per capita income half of the US level has a nontraded expenditure share which is 0.01-0.06 lower than in the US. These figures are representative of the whole cross-sectional evidence. Importantly, there are no notable differences in expenditure shares across different regions of the world. As with the time-series evidence, this result is particularly remarkable given the large differences in relative prices of traded and nontraded goods in investments between poor and rich countries.

Our cross-section results differ from findings in Burstein et al. (2004), who in a sample of 19 countries find a significant negative correlation between the investment expenditure

[15] The two exceptions to this rule are Latin America in the 1960s and Africa in the 1990s. In both cases, the number of countries in the regional group was less than seven.

share on nontraded goods and real per capita income. To reconcile the results of the two studies, Table 12 presents the results of Burstein et al. (2004) and replicates their study using the data of our paper. Columns 1-5 of the table present the results of Burstein et al. (2004). The fourth column presents the share of construction sector output in investment expenditures. The fifth column presents the same share for all nontraded sectors, defined in Burstein et al. (2004) as construction, retail/wholesale trade and real estate/business services. All expenditure data, except for Brazil, are obtained from input-output tables. Notice that the data for each country refer to some year over the 1990-1999 period, presented in the second column.

The last three columns of the table present comparable data from each of our datasets. In the case of the UN data, the comparison is restricted by the fact that for most countries, the data series end in 1996-97 and therefore six of the observations are missing. For the OECD data, the comparison is restricted by the fact that our dataset only covers selected OECD countries and the Burstein et al. (2004) sample includes several non-OECD countries. Consequently, six observations are also missing. In the case of the PWT data, we are restricted to using 1996 data for each country.

Burstein et al. (2004) find that construction expenditures and per capita income have a correlation coefficient of -0.69, while for all nontraded expenditures, this coefficient is -0.64. The correlation coefficients in the three comparable samples from our datasets are also negative, but smaller, ranging from -0.01 to -0.29.[16]

What explains the large differences in correlation between real income per capita and investment expenditure shares in our paper and Burstein et al. (2004)? The negative correlation coefficients at the bottom of the last three columns of Table 9 indicate that, at least partly, the differences are due to the particular years from which the Burstein et al. (2004) sample is selected. For nine countries out of nineteen, the data are for the 1995-96 period. Cross-section results in Table 7 show that for these two particular years, the UN data also exhibit negative correlations between per capita income and expenditure shares (-0.15 in 1995 and -0.23 in 1996). However, these two years are very clear outliers when compared to the whole 1954-1997 period.[17]

The remaining differences are likely to stem from the limited sample size in the

[16] Data used in this paper also offers an alternative estimate of correlation, based on input-output table data. Using such data for 10 OECD countries over 1970-1990 period (see Table 1 and OECD (2000a)) we find that the correlation between the investment expenditure share on nontraded goods and real per capita income is -0.11.

[17] In the PWT 1996 benchmark data, the correlation between per capita income and expenditure shares is 0.12. However, as already noted, 1996 data for African countries in this dataset appear to contain an error. If the African countries are excluded, the PWT 1996 benchmark data also exhibit a small negative correlation between income and expenditure shares.

Burstein et al. (2004) study. Note from Table 10 that for subgroups of countries in the UN dataset, it is not uncommon to find correlations with per capita income that differ significantly from the correlation in the aggregate sample. For example, in 1981 the expenditure shares–income correlation for eleven South East Asian countries is -0.42. In the same year we find a correlation of -0.36 for sixteen African countries. At the same time, the average correlation for the whole UN sample for the same year is -0.01. Significant deviations in correlation coefficients can also be found for Europe and Latin America.

3.3 Compatibility with existing empirical regularities

Our empirical findings fit well with the body of already established empirical regularities, which provides an additional reliability check for our results.

First, consider the empirical fact that the relative price of nontraded goods increases with the level of income. Combined with our findings about investment expenditures, this implies that, as per capita income increases, investments become more intensive in traded goods or equipment. In a series of papers, Summers and De Long (1991, 1993) conclude this to be the case in the data. They find a strong positive correlation between equipment intensity of investments and economic growth.

Second, Eaton and Kortum (2001) note that *domestic price* investments in equipment, as a share of GDP, do not vary systematically with the level of income. Together with our findings, this implies that aggregate *domestic price* investment rates also should not vary systematically with income. Parente and Prescott (2000) find that this indeed is the case for a wide set of countries over the 1960-2000 period. The same empirical fact is also stressed by Hsieh and Klenow (2003) and Restuccia and Urrutia (2001). Note that findings in Burstein et al. (2004) imply that either the *domestic price* investment rates are decreasing with income or *domestic price* investment rates in equipment are increasing with income and thus, contradict previous findings in the literature.

4 A theoretical implication: Can the Balassa-Samuelson effect account for investment rate differences between rich and poor countries?

One of the most consistent empirical growth facts is that *international price* investment rates in rich countries are 2-3 times higher than in poor countries. In this section, we look at the implications of our empirical findings for the theoretical literature that investigates sources of the significant difference in investment rates.[18]

To provide a convincing explanation for the differences in investment rates, a theoretical model needs to satisfy two closely related empirical regularities. First, the relative price of nontraded goods is increasing with income and second, *domestic price* investment rates do not correlate with income. Restuccia and Urrutia (2001) show that, among other possible explanations such as distortionary policies in poor countries, differences in international price investment rates can be the result of differences in relative productivity in the production of investment and consumption goods. This finding is taken one step further by Hsieh and Klenow (2003). The authors argue that differences in the relative price of nontraded goods across income are driven by differences in the price of nontraded, rather than traded, goods. Consequently, they use a small open economy two-sector growth model and show that only productivity differences in the production of consumption and investment goods can account for the differences in *international price* investment rates.

These findings beg for a question: what stands behind the differences in relative productivity between sectors producing investment and consumption goods? Hsieh and Klenow (2003) suggest the Balassa-Samuelson effect to be the prime candidate for explaining such differences. Our empirical findings, however, show that in rich as well as poor countries, the investment expenditures on nontraded goods are at least as large as the expenditures on traded goods. Thus, the often used notion that investment goods are traded while consumption goods are nontraded contradicts the empirical evidence.

In this section, we investigate to what extent the differences in investment rates between rich and poor countries can be generated with the two-sector small open economy growth model, when nontraded and traded goods in investments and consumption are correctly accounted for. This is equivalent to asking to what extent the required productivity differences in production of investment and consumption goods can be assigned to differences in the traded-nontraded nature of sectoral output.

4.1 Theoretical framework

We start by presenting a simple two-sector small open economy growth model, which is sufficiently general to accommodate most of the formulations that have been used in the literature. Importantly, the model setup allows for traded and nontraded goods to be used in both investments and consumption. To keep the model simple and focus on

[18] Ultimately, the goal of this literature is to explain income differences across countries, but for the purpose of this paper, the attention is restricted to explaining differences in investment rates.

the main task, it is formulated in a deterministic environment. Moreover, we ignore any labor-leisure considerations.

The representative consumer in the model solves

$$\max_{\{c_{Tt}, c_{Nt}, k_{Tt+1}, k_{Nt+1}, l_{Tt}, l_{Nt}, b_{t+1}\}} \sum_{t=0}^{\infty} \beta^t u(F_C(c_{Tt}, c_{Nt})),$$

subject to the following per-period budget constraint

$$c_{Tt} + p_{Nt}c_{Nt} + q_{t+1}F_I(x_{Tt}, x_{Nt}) + b_{t+1} \leq (1 + r_t)b_t + p_{Nt}F_N(k_{Nt}, l_{Nt}) + F_T(k_{Tt}, l_{Tt}).$$

Here, β is the subjective discount rate; c_{Tt} and c_{Nt} represent traded and nontraded components of consumption, which through the function $F_C(c_{Tt}, c_{Nt})$ are aggregated into consumption goods; the total inelastic labor supply in the economy is normalized to unity so that in every period, $l_{Tt} + l_{Nt} = 1$; k_{Tt} and k_{Nt} are capital stocks in traded and nontraded sectors, which together with labor input produce sectoral output with $F_j(k_{jt}, l_{jt}), j \in \{T, N\}$; $F_I(x_{Tt}, x_{Nt})$ represents new investments, which can be purchased at a price q_{t+1}; b_t is outstanding foreign assets; and r_t is the interest rate charged on foreign assets. The price of the traded good is used as the numeraire.

The resource constraints for traded and nontraded sectors of the economy are

$$\begin{aligned} c_{Nt} + x_{Nt} &\leq F_N(k_{Nt}, l_{Nt}) \\ c_{Tt} + x_{Tt} + b_{t+1} - b_t(1 + r_t) &\leq F_T(k_{Tt}, l_{Tt}). \end{aligned}$$

The output in each sector can be used either for consumption, c_j, or investment, x_j, purposes. In the traded sector, the difference between domestic absorption and output is equal to the trade balance.

Capital in this economy is accumulated according to

$$k_{Tt+1} + k_{Nt+1} = (1 - \delta)(k_{Tt} + k_{Nt}) + F_I(x_{Tt}, x_{Nt}),$$

where δ is the depreciation rate and in each period, $F_I(x_{Tt}, x_{Nt})$ is acquired from the investment production sector.

Producers of investment goods solve

$$\max_{\{x_{Tt}, x_{Nt}\}} q_{t+1}F_I(x_{Tt}, x_{Nt}) - x_{Tt} - p_{Nt}x_{Nt},$$

so that new investment goods in the economy are potentially produced using the output of both traded and nontraded sectors.

In the framework of this model, the setup with traded investment goods and nontraded consumption goods corresponds to assuming that $F_C(c_{Tt}, c_{Nt}) = c_{Nt}$ and $F_I(x_{Tt}, x_{Nt}) = x_{Tt}$. Hsieh and Klenow (2003) show that under such assumptions, a relatively higher productivity in the investment sector (relative to the consumption sector) in rich countries leads to (i) higher relative prices of nontraded goods in rich countries and (ii) higher *international price* investment rates in rich countries, while *domestic price* investment rates are the same in rich and poor countries. All three of these model predictions find strong empirical support.

The spirit of our investigation is to examine whether these three empirically relevant results can be generated in a model where productivity differences are due to traded relative to nontraded sectors of economic activity. Our empirical results suggest that this is not identical to assigning productivity differences to investment and consumption sectors. We examine both qualitative and quantitative predictions of the model.

4.2 Analytical solution

It is instructive to start the investigation by considering the analytical solution of the two-sector growth model presented in Section 4.1. Motivated by earlier empirical findings, we assume that traded and nontraded goods are aggregated into investments using

$$F_I(x_{Tt}, x_{Nt}) = G x_{Tt}^{\gamma} x_{Nt}^{1-\gamma}. \tag{1}$$

In the model, this imposes constant investment expenditure shares on traded and nontraded goods. The production function in traded and nontraded sectors is assumed to be

$$F_j(k_{jt}, l_{jt}) = A_j k_{jt}^{\alpha} l_{jt}^{1-\alpha} \quad \text{for} \quad j \in \{T, N\}.$$

Traded and nontraded goods are aggregated in consumption goods through

$$F_C(c_{Tt}, c_{Nt}) = c_{Tt}^{\varepsilon} c_{Nt}^{1-\varepsilon}, \tag{2}$$

so that consumption expenditures on traded and nontraded goods are also constant. The assumed functional form for the consumption aggregator is chosen because of its analytical convenience. It will be relaxed in the latter part of this section.

Outcomes of the model are evaluated by comparing solutions for model economies with differing relative productivities in traded and nontraded production sectors, in particular

$$\left(\frac{A_T}{A_N}\right)^{rich\ country} > \left(\frac{A_T}{A_N}\right)^{poor\ country}.$$

In all other respects, model economies are identical. To avoid an additional layer of complexity, we assume that all model economies are in a steady state with a zero external asset position, i.e., $b = 0$. Each country is a small open economy and takes the world interest rate as given.

The analytical solution of the model's steady state is presented in Appendix B. Here, we present only the part of the solution that is relevant for our discussion. The expression for the domestic price steady state investment rate in the model is

$$\frac{I}{Y} = \frac{x_T + p_N x_N}{x_T + c_T + p_N\left(c_N + x_N\right)} = \frac{\alpha\delta}{r+\delta}. \tag{3}$$

The investment rate is positively related to the capital income share and negatively related to the return on capital. This result is the same as in the model with fully traded investments and nontraded consumption. Since the investment rate in (3) does not depend on productivity levels in the two sectors, all countries exhibit the same constant domestic price investment rates. The investment expenditure share on nontraded goods in the model is also the same in all countries and equal to

$$\frac{p_N x_N}{x_T + p_N x_N} = (1-\gamma).$$

This result follows directly from the functional form imposed in (1).

The relative price of nontraded goods in terms of traded goods, p_N, in the model satisfies

$$p_N = \frac{A_T}{A_N}. \tag{4}$$

Model economies exhibiting a higher relative productivity in the traded sector will also exhibit a higher relative price of nontraded goods. This result is also the same as that in the model with fully traded investments and nontraded consumption.

With the relative price of nontraded goods varying across countries, model outcomes expressed in common prices will differ from outcomes expressed in domestic prices. To compare model outcomes expressed in terms of common prices across countries, the relative price of nontraded goods is kept fixed at p_N^{PPP} and the effect of productivity changes on steady state quantities is examined.

Since investment expenditure shares on traded and nontraded goods are constant, changes in the relative price of nontraded goods imply that the model economy with higher relative productivity in the traded sector exhibits higher equipment intensity in investments. This is in line with the empirical evidence presented in De Long and Summers (1991, 1993).

The international price investment rate in the model can be expressed as

$$\frac{I^{PPP}}{Y^{PPP}} = \frac{x_T + p_N^{PPP} x_N}{x_T + c_T + p_N^{PPP}\left(c_N + x_N\right)}, \tag{5}$$

$$\frac{I^{PPP}}{Y^{PPP}} = \frac{\frac{\alpha\delta}{r+\delta}\left[1 - \gamma\left(1 - \frac{A_T}{A_N} / \frac{\widetilde{A}_T}{\widetilde{A}_N}\right)\right]}{1 - \left[\gamma\frac{\alpha\delta}{r+\delta} + \varepsilon\left(1 - \frac{\alpha\delta}{r+\delta}\right)\right]\left(1 - \frac{A_T}{A_N} / \frac{\widetilde{A}_T}{\widetilde{A}_N}\right)},$$

where $\widetilde{A}_T/\widetilde{A}_N = p_N^{PPP}$ denotes the sectoral productivity ratio in the base country. Equation (5) shows that in terms of a common international price, the investment rate is affected by the deviation of the sectoral productivity ratio from the same ratio in the base country. If $A_T/A_N = \widetilde{A}_T/\widetilde{A}_N$, then (5) reduces to (3). It can further be shown that

$$\frac{\partial \frac{I^{PPP}}{Y^{PPP}}}{\partial \frac{A_T}{A_N}} = (\gamma - \varepsilon)\frac{\frac{\delta\alpha}{r+\delta}\left(1 - \frac{\delta\alpha}{r+\delta}\right)\frac{\widetilde{A}_T}{\widetilde{A}_N}}{\left[1 - \left[\gamma\frac{\alpha\delta}{r+\delta} + \varepsilon\left(1 - \frac{\alpha\delta}{r+\delta}\right)\right]\left(1 - \frac{A_T}{A_N} / \frac{\widetilde{A}_T}{\widetilde{A}_N}\right)\right]^2}. \tag{6}$$

According to (6), model economies with a higher relative productivity in the traded sector exhibit higher international price investment rates if $\gamma > \varepsilon$, and vice versa if $\gamma < \varepsilon$. The intuition behind this result is simple. In the model, both investment and consumption expenditure shares on traded and nontraded goods are constant across countries. When traded goods play a more important role in investments than consumption, i.e. $\gamma > \varepsilon$, and the relative price is fixed at p_N^{PPP}, higher relative productivity in traded sector increases the weight of investments in output at the expense of consumption. As a result, in term of a common price, higher relative productivity in the traded sector leads to a higher investment rate.

We conclude that subject to the condition that $\gamma > \varepsilon$, the model with traded and nontraded goods in both consumption and investments delivers qualitatively the same results as the more restrictive version of the model with only traded goods in investments and only nontraded goods in consumption.

4.3 Quantitative results

Are the investment rate differences in the model quantitatively important, when compared to the data? To answer this question, we compare the differences in *international price* investment rates in the data with the differences that can be generated in a parametrized two-sector model.

We start by summarizing the empirical evidence. The best available data comparing *international price* investment rates across countries are from the PWT dataset. For illustrative purposes, Table 13 presents the relevant data from the PWT 1996 benchmark, with countries grouped according to their real GDP per worker relative to the US. In line with earlier empirical findings, *domestic price* investment rates do no vary systematically with income, while *international price* investment rates in rich countries are 2-3 times higher than in poor countries. A similar magnitude of differences in *international price* investment rates has been found by other studies (see Hsieh and Klenow (2003)).

The last two rows in Table 13 compare prices of traded and nontraded goods across income levels. Traded goods prices are represented by the price of machinery and equipment, while nontraded goods prices are represented by the prices of structures. As can be expected, the relative price of nontraded goods in terms of traded goods increases with income. Further, as already pointed out by Hsieh and Klenow (2003), the price of traded goods does not correlate with income. Hence, differences in the relative price are driven by differences in the price of nontraded goods between rich and poor countries.

The magnitude of price differences exhibits a substantial variation depending on the subset of goods and services considered, as well as the year of the benchmark data.[19] However, most of the estimates can be put in the boundaries of 3-8 times higher relative prices of nontraded goods in the rich countries. Given the uncertainty surrounding the magnitude of differences in the relative price, a wide range of price differences will be considered.

Turning to the model, first recall that the only source of heterogeneity in model outcomes is the difference in relative productivity across model economies. To compare model outcomes with the data, we use equation (4) to generate the observed differences in the relative price of nontraded goods between rich and poor countries. The performance of the model is then evaluated by comparing differences in *international price* investment rates in the model and the data.

To parametrize the model, we set the capital income share, α, equal to 1/3. This is a standard value in the literature. Gollin (2002) finds no correlation between capital income shares and the level of income. There is also evidence of capital income shares being very similar in highly aggregated sectors of economic activity, such as the traded and nontraded (see Parente and Prescott (2000)). The discount rate is set at $\beta = 0.964$

[19] For example, Hsieh and Klenow (2003) measure the price of nontraded goods using a subset of consumed services. Their estimated price elasticity with respect to income in the PWT 1980 and 1985 benchmarks suggests the price of nontraded goods in rich countries to be around 4 times higher than in poor countries. In the 1996 benchmark, the estimated difference is twice as large.

and the depreciation rate at $\delta = 0.073$. These two values are chosen so that the *domestic price* investment rate in model economies is the same as in Table 13, i.e. 0.22, and the capital output ratio is equal to 3.0.

As a benchmark for further discussion, we first consider the model specification with fully traded investments and nontraded consumption, which corresponds to assuming that $\varepsilon = 0$ in equation (2) and $\gamma = 1$ in equation (1). The results of the benchmark parametrization are summarized with the solid line in Figure 9. In this figure, the x-axis represents the relative price of nontraded goods in the poor model economy as a fraction of the relative price in the rich model economy. The Y-axis represents the *international price* investment rate in the poor model economy, with the rich model economy taken as the base country. Thus, on both axes, the value of 1 corresponds to the rich model economy. According to the data, the empirically relevant range on the x-axis is between 0.125-0.33 and on the y-axis**,** it is between 0.33-0.5. The magnitude of differences in the *international price* investment rates observed in the data can be rather closely matched with the benchmark model specification.

In the second model specification, motivated by the empirical results of this paper, we set the investment expenditure share on nontraded goods, γ, in equation (1) equal to 0.40. For aggregation of consumption in equation (2), we set $\varepsilon = 0.25$. This particular parameter value is taken from Burstein et al. (2004), who estimate the consumption expenditure share on traded goods in medium and high income countries to be 1/4 of the aggregate consumption expenditures.[20] Note that the parameter values for ε and γ imply that consumption is more intensive in nontraded goods than investments, and therefore from (6), we know that the model's *international price* investment rate will increase with the level of income.

The corresponding solution in Figure 9 shows that with this empirically motivated parametrization, the model can only account for 15-30 percent of the differences in *international price* investment rates between rich and poor countries. Note that this conclusion does not depend on the magnitude of differences in the relative price of nontraded goods.

Differences in outcomes of the two model parametrizations can be better understood by considering the relevant ratio from the model's analytical solution

$$\frac{(I/Y)^{PPP}_{poor}}{(I/Y)^{PPP}_{rich}} = \frac{\left(1 - \frac{A_T}{A_N} / \frac{\widetilde{A}_T}{\widetilde{A}_N}\right)^{-1} - \gamma}{\left(1 - \frac{A_T}{A_N} / \frac{\widetilde{A}_T}{\widetilde{A}_N}\right)^{-1} - \left[\gamma \frac{I}{Y} + \varepsilon \left(1 - \frac{I}{Y}\right)\right]}. \tag{7}$$

[20] We found the same average expenditure share also in the OECD input-output tables for 1990.

The ratio in (7) is obtained from (5), where we have substituted in the expression for *domestic price* investment rate from (3). As in Figure 9, the rich model economy is taken as the base country, so that $\frac{A_T}{A_N}/\frac{\widetilde{A}_T}{\widetilde{A}_N} < 1$.

Compare the second term in the numerator and denominator of equation (7): γ and $\gamma\frac{I}{Y} + \varepsilon\left(1 - \frac{I}{Y}\right)$. The latter term is a weighted average of investment and consumption expenditure shares on traded goods, weighted by investment and consumption rates correspondingly. First, note that for the ratio in (7) to be less than unity, we need $\varepsilon < \gamma$. Second, ceteris paribus, the ratio is smaller the larger is γ and the smaller is ε. Hence, the ratio is smaller the larger is the difference $\gamma - \varepsilon$.

The benchmark parametrization can therefore be interpreted as the extreme case, which allows for maximum differences in expenditure shares and, consequently, maximum differences in *international price* investment rates. Intuitively, it is then clear that if the model solution with the most favorable values of γ and ε can closely match the differences in investment rates, only a fraction of the investment rate differences can be accounted for under the more realistic parametrization.

We should also note the limited effect of differences in sectoral productivities on the *international price* investment rates. In the extreme case with $\frac{A_T}{A_N}/\frac{\widetilde{A}_T}{\widetilde{A}_N} \to 0$, the investment rate ratio in (7) can be written as

$$\frac{(I/Y)^{PPP}_{poor}}{(I/Y)^{PPP}_{rich}} = \frac{1-\gamma}{1-\left[\gamma\frac{I}{Y} + \varepsilon\left(1-\frac{I}{Y}\right)\right]}. \tag{8}$$

Thus, although larger variation in sectoral productivity ratios does increase the differences in *international price* investment rates, asymptotically its effect is limited to (8).

4.4 Sensitivity analysis of numerical results

How sensitive are the results in Figure 9 to the assumed values of β, δ and α? Equation (7) together with equation (3) show that the discount factor, depreciation rate and capital income share only affect the *international price* investment rate through their effect on weights, I/Y and $1 - I/Y$, for the two expenditure shares. Thus, as long as the model is restricted to exhibiting a reasonable domestic price investment rate, which for our parametrization is 0.22, the results in Figure 9 are not sensitive to values of β, δ and α. Furthermore, since there is substantial empirical evidence that *domestic price* investment rates do not correlate with income, any correlation between parameters β, δ, α and income should not affect the results in Figure 9.

The extensive empirical evidence presented in this paper suggests that around 60 percent of the investment expenditures are spent on nontraded goods, and that this share does not vary systematically with the level of income. However, the available evidence for consumption expenditures is more scarce. To deal with this shortcoming, Figure 9 also depicts the solution of model parametrization with $\gamma = 0.40$ and only nontraded goods in consumption, i.e. $\varepsilon = 0$. In this case, the model accounts for 40-60 percent of the investment rate differences. This parametrization provides the upper bound for the investment rate differences for which the model can potentially account, give that $\gamma = 0.40$.

We also consider an alternative aggregation function for consumption goods. Stockman and Tesar (1995) report the elasticity of substitution between traded and nontraded goods in consumption to be 0.44 rather than unitary, so that instead of (2), consumption is aggregated through

$$F_C(c_{Tt}, c_{Nt}) = \left(\mu c_{Tt}^{\frac{\theta-1}{\theta}} + (1-\mu)\, c_{Nt}^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}},$$

where $\theta = 0.44$ and μ is a weight parameter. With less than unitary elasticity of substitution between traded and nontraded goods in consumption, the expenditure share on nontraded goods will be higher for model economies with higher relative prices of nontraded goods, i.e. the rich model economy. This is the case since with $\theta < 1$, the price increase is not fully offset by the decrease in quantity and, consequently, the expenditure share increases.

The result that the consumption expenditure share on nontraded goods is higher in countries with higher income levels agrees with the often reported observation (see e.g. Kravis (1982), p. 194) that the share of nontraded sector output in GDP is higher in OECD countries than in less developed countries.[21] In this case, weight parameter μ is set so that in the rich model economy, the consumption expenditure share on nontraded goods is 0.25, as reported in Burstein et al. (2004).[22] With this model specification, the difference in the nontraded expenditure share between consumption and investments,

[21] To make this connection, we (i) use the empirical result of our paper concerning constant investment expenditure shares on traded and nontraded goods and (ii) assume that the trade balance across countries does not vary systematically with the income level. In this case, all variation in nontraded sector output to GDP across countries is absorbed by consumption expenditures.

[22] We do not report the value of ε since in the CES setting, it has no economic meaning. As in the case of unitary elasticity of substitution, with the CES functional form for consumption aggregation, the results in Figure 9 only depend on the productivity ratios $\frac{A_T}{A_N}/\frac{\tilde{A}_T}{\tilde{A}_N}$. The results are independent of the level of productivity in traded and nontraded sectors, A_T and A_N. A change in the level of the productivity ratio, A_T/A_N, requires a change in ε, but does not otherwise affect the results. See Appendix B.3 for details.

i.e. $\gamma - \varepsilon$, in the poor model economy is, in fact, smaller than in the case with a Cobb-Douglas aggregator. Thus, not surprisingly, the *international price* investment rate in the poor model economy is higher than in any of the earlier model solutions.

For the sake of completeness, we also consider elasticities reported by two other empirical studies. Mendoza (1995) finds that in OECD countries, $\theta_{rich} = 0.74$, while Ostry and Reinhart (1992) find that for some regions of less developed countries, $\theta_{poor} = 1.3$. With such a model specification, we allow the elasticity of substitution between traded and nontraded goods in consumption to differ between rich and poor model economies. As with the previous model specification, the weight μ is set to match consumption expenditure shares in the rich model economy. To avoid an assumption about the exact relationship between the intratemporal elasticity of substitution and income, results from this parametrization are not depicted in Figure 9. Comparing only a rich and a poor model economy, we find that in this case, the model can account for 30-50 percent of the investment rate differences. Note that under no CES parametrization can the model explain more than in the case of $\gamma = 0.40$ and $\varepsilon = 0$.

We conclude that the generalization of a growth model with traded investment goods and nontraded consumption goods to a case with traded and nontraded goods in both consumption and investments leads to no qualitative differences in model outcomes, as long as the traded good expenditure share in investments exceeds the traded good expenditure share in consumption. Empirically, this appears to be a reasonable restriction for the more general model. At the same time, for quantitative results, the generalization considerably decreases the model's ability to account for differences in international price investment rates between developed economies and less developed countries. With reasonable parameter values, the model can only account for around 10-40 percent of the interest rate differences, depending on the assumed parameter values.

Our results suggest that the relative productivity differences between traded and nontraded goods cannot be the main cause for the differences in *international price* investment rates between rich and poor countries. The driving force behind this result is the empirical finding that nontraded goods play a dominant role in both consumption and investments.

5 Concluding remarks

Setting up a two-sector open economy growth model requires an assumption about the role of traded and nontraded goods in the capital accumulation process. A common practice in the literature is to assume that only traded or only nontraded goods can be transformed into investments. In a survey of the topic, Turnovsky (1997) concludes that 'no one assumption has gained a uniform acceptance', since these assumptions are driven by mere convenience considerations rather than empirical facts. Furthermore, model results are often sensitive to the assumption used.

Although there is some variation across countries, we find that, on average, expenditures on nontraded and traded goods account for 60 and 40 percent of all investment expenditures, respectively. Furthermore, the investment expenditure shares on traded and nontraded goods have been close to constant over the last 50 years and exhibit a small positive correlation with the level of income. These results are particularly remarkable, given the large variation in relative prices across both time and income levels.

Our empirical results indicate that model outcomes that are more in line with the data can be obtained with relatively little additional complexity. There are, in fact, several models in the literature that satisfy our empirical restriction, although the empirical motivation for the particular modeling choice has been missing. In this paper, we have concentrated on the traded-nontraded nature of sectoral output; however, our results are also applicable to models distinguishing between equipment and structures in investments.

With our empirical restriction imposed on a two-sector small open economy growth model, only around 25 percent of the differences in *international price* investment rates between rich and poor countries can be attributed to differences in relative productivity between traded and nontraded sectors, i.e., the Balassa-Samuelson effect. Thus, this effect is not the main cause for the differences in *international price* investment rates.

Our empirical results would also affect the transition dynamics in a two-sector model. As Turnovsky (1997), Fernandez de Cordoba and Kehoe (2000) and, more recently, Burstein et al. (2004) have pointed out, an investment process with traded and nontraded goods in a two-sector open economy model can have the same effect as the standard investment adjustment costs and thus help generate more plausible investment dynamics. We leave the study of such effects to future research.

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A Data issues

A.1 Estimates of the bias, due to investment expenditures on 'retail/wholesale trade' and 'real estate/business services'

A problem accompanying the use of the more widely available national accounts is that the detailed fixed capital formation data cannot be directly mapped into investment expenditures on traded and nontraded goods. In national accounts, all investment expenditures are divided into expenditures on producer durables (e.g. machinery, equipment) and structures (e.g. manufacturing buildings, residential buildings). Expenditures on output of nontraded sectors, other than construction, are bundled together with either expenditures on construction or producer durables and can therefore lead to an underestimation of the expenditure share of nontraded goods. In practice, around 98 percent of the investment expenditures are accounted for if we only add two other nontraded sectors: retail/wholesale and real estate/business services.

To estimate the size of the investment expenditures, which from a 'traded-nontraded output' perspective are incorrectly booked in the NA GFCF data, we consider 42 input-output tables for ten OECD countries. These tables cover the period 1970-1990 (see OECD (2000a) for details). Data from input-output tables are compared with NA data for investment expenditures on producer durables and structures. Such comparative data are presented in Table A1.

In Table A1, we should find that the weight for investment expenditures on nontraded goods from input-output data always exceeds the weight obtained from NA data. The size of the difference shows the bias in the NA data for a particular country and a particular year. In Table A1, the expected sign of the difference between weights in input-output and NA data is, in fact, not satisfied for three countries out of ten (Canada, France and Germany). This is probably due to poor compatibility of data. In particular, the much greater detail of the input-output tables often means that it is not fully compatible with data gathered according to NA definitions (see OECD (2000a, 2000b) for a more detailed discussion).

Subject to such compatibility problems, we compare the average differences for the ten sample countries, presented in the last row of Table A1. In this case, the sign of the difference is as expected and the size suggests that NA data underestimate the expenditure weight of nontraded goods by 0.040-0.059. There is no table time trend in the size of the bias.

A similar estimate of the bias is obtained by comparing input-output table data in Burstein et al. (2004) with the corresponding weights in NA data. The results suggest a bias of 0.042 (see Table A2).

A.2 Traded and nontraded intermediate inputs in the production of structures and equipment

Although models with traded and nontraded goods do not usually model intermediate production sectors, in some cases it might be of interest to know the size of the intermediate input of traded goods in the production of nontraded goods for investments and vice versa. The nontraded sector, in particular construction, uses a large amount of intermediate traded inputs and producers of investment goods in the traded sector use nontraded intermediate inputs, such as distribution services. The actual size of these intermediate 'cross inputs' cannot be precisely estimated from the input-output tables, since these do not differentiate between traded and nontraded intermediate inputs in sectoral production for investment and consumption purposes.

To obtain an estimate of the size of these 'cross effects', we calculate the fraction of traded intermediate inputs in the gross output of construction sector. The same fraction is also calculated for a subset of manufacturing sectors which constitutes a majority of traded investments. We do not consider this fraction for all traded and nontraded sectors, since for sectors that were omitted, most of the final use is consumption, not investments. It is likely that intermediate inputs are not equally important for these two components of final demand. The fractions we obtain, expressed as 'intermediate input/gross output' are similar across OECD countries (see Table A3). The average size of traded intermediate input in construction is 31 percent of the gross output. The intermediate input of nontraded goods for the selected subset of the manufacturing sector is 17 percent of gross output.

These estimates suggest that in a model with intermediate traded and nontraded inputs, the weight of aggregate investment expenditures on nontraded goods should be lower than in a model without intermediate inputs. In particular, if the estimated investment expenditure share in Section 3 (adjusted for the bias discussed in A.1) is 0.60, then in a model with intermediate traded and nontraded goods, the same share is 0.48, obtained as $0.60 * (1 - 0.31) + 0.40 * 0.17 = 0.48$.

Table A1: Comparison of investment expenditures on nontraded goods in input-output tables and national accounts

Country	Data source\Period	Pre-1973	Mid/late-70s	Early-80s	Mid-80s	1990
Australia	input-output data	0.687	0.721		0.673	0.675
	NA data		0.530		0.500	0.520
	difference		0.191		0.173	0.155
Canada	input-output data	0.654	0.620	0.606	0.579	0.604
	NA data	0.710	0.690	0.660	0.650	0.650
	difference	-0.056	-0.070	-0.054	-0.071	-0.046
Denmark	input-output data	0.738	0.669	0.675	0.590	0.599
	NA data	0.680	0.610	0.600	0.500	0.500
	difference	0.058	0.059	0.075	0.090	0.099
France	input-output data	0.672	0.677	0.518	0.483	0.480
	NA data	0.580	0.580	0.560	0.530	0.480
	difference	0.092	0.097	-0.042	-0.047	0.000
Germany	input-output data		0.576	0.528	0.513	0.499
	NA data		0.600	0.560	0.550	0.540
	difference		-0.024	-0.032	-0.037	-0.041
Italy	input-output data			0.606		
	NA data			0.500		
	difference			0.106		
Japan	input-output data	0.636	0.723	0.733	0.659	0.687
	NA data	0.520	0.570	0.570	0.520	0.560
	difference	0.116	0.153	0.163	0.139	0.127
Netherlands	input-output data	0.674	0.653	0.672	0.577	
	NA data	0.640	0.620	0.630	0.520	
	difference	0.034	0.033	0.042	0.057	
UK	input-output data	0.570	0.526		0.561	0.599
	NA data		0.460		0.460	0.510
	difference		0.066		0.101	0.089
USA	input-output data	0.632	0.606	0.623	0.609	0.593
	NA data	0.620	0.580	0.560	0.550	0.520
	difference	0.012	0.026	0.063	0.059	0.073
Average	**input-output**	**0.668**	**0.641**	**0.620**	**0.583**	**0.592**
	national accounts	**0.625**	**0.582**	**0.580**	**0.531**	**0.535**
	difference	**0.043**	**0.059**	**0.040**	**0.052**	**0.057**

Data sources: For input-output table data, see OECD (2000a), for national accounts data, see OECD (2004). The exact years of comparison are reported in Table 1.

Table A2: Comparison of investment expenditures on nontraded goods in Burstein et al. (2004) and national accounts

Country	Burstein et al. (2004)	NA data*	Difference
Korea	0.601	0.666	-0.065
Mexico	0.635	0.502	0.133
Australia	0.627	0.491	0.136
Canada	0.596	0.649	-0.053
Chile	0.677	0.530	0.147
Denmark	0.587	0.457	0.130
Finland	0.564	0.524	0.040
France	0.562	0.485	0.077
Germany	0.546	0.640	-0.094
Greece	0.711	0.602	0.109
Italy	0.586	0.498	0.088
Japan	0.653	0.552	0.101
Netherlands	0.532	0.544	-0.012
Norway	0.458	0.653	-0.195
Spain	0.638	0.572	0.066
UK	0.481	0.427	0.054
US	0.527	0.470	0.057
Average	**0.587**	**0.545**	**0.042**

Data sources: Burnstein et al. (2004) and OECD (2004).
* OECD data complemented with UN data for Chile, Australia, Mexico and Korea.

Table A3: Intermediate 'cross inputs' in traded and nontraded investment goods, as a fraction of gross output

Country	Year	Nontraded into traded	Traded into nontraded
Australia	1989	0.15	0.35
Canada	1990	0.09	0.30
Denmark	1990	0.15	0.30
France	1990	0.23	0.29
Germany	1990	0.20	0.33
Italy	1985	0.18	0.34
Japan	1990	0.19	0.33
Netherlands	1986	0.12	0.30
UK	1990	0.19	0.22
US	1990	0.16	0.31
Average		0.17	0.31

Data source: OECD (2000a).

B Model with traded and nontraded goods in consumption and investments

B.1 Steady-state solution of the model

The steady-state solution of the model presented can be characterized by the following system of ten equations and ten unknowns

$$\begin{cases} \frac{1-\varepsilon}{\varepsilon}\frac{c_T}{c_N} - p_N = 0 \\ q(1-\gamma)Gx_T^{\gamma}x_N^{-\gamma} - p_N = 0 \\ q\gamma G x_T^{\gamma-1}x_N^{1-\gamma} - 1 = 0 \\ p_N \alpha A_N k_N^{\alpha-1} l_N^{(1-\alpha)} - q(r+\delta) = 0 \\ \alpha A_T k_T^{\alpha-1} l_T^{(1-\alpha)} - q(r+\delta) = 0 \\ Gx_T^{\gamma}x_N^{1-\gamma} - \delta\left(k_T + k_N\right) = 0 \\ A_T k_T^{\alpha} l_T^{(1-\alpha)} - c_T - x_T = 0 \\ A_N k_N^{\alpha} l_N^{(1-\alpha)} - c_N - x_N = 0 \\ p_N A_N k_N^{\alpha} l_N^{-\alpha} - A_T k_T^{\alpha} l_T^{-\alpha} = 0 \\ L - l_T - l_N = 0. \end{cases} \tag{9}$$

Note that in the steady state, foreign asset position, b, is treated as exogenous and is set equal to zero. L denotes the inelastic aggregate labor supply in the economy. To solve the system, we use equations 2, 3, 4, 5 and 9 in (9) to solve for

$$\begin{aligned} \frac{x_T}{x_N} &= \frac{A_T}{A_N}\frac{\gamma}{(1-\gamma)}, \\ p_N &= \frac{A_T}{A_N}, \\ q &= \left(\frac{A_T}{A_N}\right)^{1-\gamma}, \\ \frac{k_T}{l_T} &= \frac{k_N}{l_N} = \left[\frac{\alpha}{r+\delta}A_T^{\gamma}A_N^{1-\gamma}\right]^{\frac{1}{1-\alpha}}, \end{aligned} \tag{10}$$

where, without loss of generality, we have set $G^{-1} = \gamma^{\gamma}\left(1-\gamma\right)^{1-\gamma}$.

Next, substituting the expressions in (10) back into the remaining equations in (9), we solve for other variables of interest. First, from equation 6 in (9), we can directly solve for

$$x_N = A_N\left(1-\gamma\right)L\frac{\delta\alpha}{r+\delta}\left[\frac{\alpha}{r+\delta}A_T^{\gamma}A_N^{1-\gamma}\right]^{\frac{\alpha}{1-\alpha}},$$

which combined with equation 1 in (10) implies that

$$x_T = A_T \gamma L \frac{\delta\alpha}{r+\delta} \left[\frac{\alpha}{r+\delta} A_T^{\gamma} A_N^{1-\gamma} \right]^{\frac{\alpha}{1-\alpha}}.$$

Equations 1, 7, 8 and 10 in (9) are then used to solve for

$$\begin{aligned}
l_N &= L - L\left(\gamma \frac{\delta\alpha}{r+\delta} + \varepsilon\left[1 - \frac{\delta\alpha}{r+\delta}\right]\right), \\
l_T &= L\left(\gamma \frac{\delta\alpha}{r+\delta} + \varepsilon\left[1 - \frac{\delta\alpha}{r+\delta}\right]\right), \\
c_T &= A_T L \varepsilon \left(1 - \frac{\delta\alpha}{r+\delta}\right) \left[\frac{\alpha}{r+\delta} A_T^{\gamma} A_N^{1-\gamma} \right]^{\frac{\alpha}{1-\alpha}}, \\
c_N &= A_N L (1-\varepsilon) \left(1 - \frac{\delta\alpha}{r+\delta}\right) \left[\frac{\alpha}{r+\delta} A_T^{\gamma} A_N^{1-\gamma} \right]^{\frac{\alpha}{1-\alpha}},
\end{aligned}$$

and substituting expressions for l_N and l_T into (10), we obtain

$$\begin{aligned}
k_N &= L\left(1 - \left(\gamma \frac{\delta\alpha}{r+\delta} + \varepsilon\left[1 - \frac{\delta\alpha}{r+\delta}\right]\right)\right) \left[\frac{\alpha}{r+\delta} A_T^{\gamma} A_N^{1-\gamma} \right]^{\frac{1}{1-\alpha}}, \\
k_T &= L\left(\gamma \frac{\delta\alpha}{r+\delta} + \varepsilon\left[1 - \frac{\delta\alpha}{r+\delta}\right]\right) \left[\frac{\alpha}{r+\delta} A_T^{\gamma} A_N^{1-\gamma} \right]^{\frac{1}{1-\alpha}}.
\end{aligned}$$

Finally, we solve for the steady-state values of output and investments. Total output can be expressed as

$$\begin{aligned}
Y &= x_T + c_T + p_N c_N + p_N x_N, \\
Y &= A_T L \left[\frac{\alpha}{r+\delta} A_T^{\gamma} A_N^{1-\gamma} \right]^{\frac{\alpha}{1-\alpha}}.
\end{aligned}$$

Expressions for total investments are

$$\begin{aligned}
I &= x_T + p_N x_N, \\
I &= A_T L \frac{\delta\alpha}{r+\delta} \left[\frac{\alpha}{r+\delta} A_T^{\gamma} A_N^{1-\gamma} \right]^{\frac{\alpha}{1-\alpha}}.
\end{aligned}$$

Thus, we have that in the steady state of the model, the investment rate is

$$\frac{I}{Y} = \frac{\delta\alpha}{r+\delta}$$

and the investment expenditure shares on nontraded goods are

$$\frac{p_N x_N}{I} = (1-\gamma).$$

It is also of interest to note here that in the steady state of the model, total output is positively related to the sectoral productivity parameters

$$\begin{aligned}\frac{\partial Y}{\partial A_T} &= \frac{1-\alpha(1-\gamma)}{1-\alpha}\frac{Y}{A_T} > 0,\\ \frac{\partial Y}{\partial A_N} &= \frac{\alpha(1-\gamma)}{1-\alpha}\frac{Y}{A_N} > 0.\end{aligned}$$

B.2 PPP comparisons for countries with different relative sectoral productivity, $\frac{A_T}{A_N}$

For PPP adjusted comparisons of model outcomes, we keep prices fixed at $p_N^{PPP} = \widetilde{A}_T/\widetilde{A}_N$ and thus, consider the effect of productivity changes on quantities only. The expression for PPP adjusted investments is

$$\begin{aligned}I^{PPP} &= x_T + p_N^{PPP} x_N,\\ I^{PPP} &= \left(A_T\gamma + \frac{\widetilde{A}_T}{\widetilde{A}_N}A_N(1-\gamma)\right)L\frac{\delta\alpha}{r+\delta}\left[\frac{\alpha}{r+\delta}A_T^{\gamma}A_N^{1-\gamma}\right]^{\frac{\alpha}{1-\alpha}}.\end{aligned}$$

The ratio $\frac{p_N^{PPP}x_N}{I^{PPP}}$, which represents PPP adjusted expenditure share on nontraded goods, is

$$\frac{p_N^{PPP}x_N}{I^{PPP}} = \left(\frac{A_T}{A_N}\frac{\widetilde{A}_N}{\widetilde{A}_T}\frac{\gamma}{(1-\gamma)} + 1\right)^{-1}.$$

We are interested in the sign of

$$\frac{\partial \frac{p_N^{PPP}x_N}{I^{PPP}}}{\partial \frac{A_T}{A_N}} = -\frac{\frac{\widetilde{A}_N}{\widetilde{A}_T}\frac{\gamma}{(1-\gamma)}}{\left(\frac{A_T}{A_N}\frac{\widetilde{A}_N}{\widetilde{A}_T}\frac{\gamma}{(1-\gamma)}+1\right)^2},$$

which is negative.

The expression for PPP adjusted output is

$$Y^{PPP} = x_T + c_T + p_N^{PPP} c_N + p_N^{PPP} x_N,$$

$$Y^{PPP} = \left(\frac{\delta\alpha}{r+\delta} \left(A_T \gamma + \frac{\widetilde{A}_T}{\widetilde{A}_N} A_N (1-\gamma) \right) + \left(1 - \frac{\delta\alpha}{r+\delta} \right) \left(A_T \varepsilon + \frac{\widetilde{A}_T}{\widetilde{A}_N} A_N (1-\varepsilon) \right) \right) *$$
$$* L \left[\frac{\alpha}{r+\delta} A_T^{\gamma} A_N^{1-\gamma} \right]^{\frac{\alpha}{1-\alpha}}.$$

We are interested in the sign of the derivative of the PPP adjusted output with respect to sectoral productivity

$$\frac{\partial Y^{PPP}}{\partial A_T} = \frac{1-\alpha(1-\gamma)}{1-\alpha} \Psi_1 A_T^{\frac{\gamma\alpha}{1-\alpha}} A_N^{\frac{\alpha(1-\gamma)}{1-\alpha}} + \frac{\gamma\alpha}{1-\alpha} \Psi_2 A_T^{\frac{\gamma\alpha-1+\alpha}{1-\alpha}} A_N^{\frac{1-\alpha\gamma}{1-\alpha}} > 0$$

and

$$\frac{\partial Y^{PPP}}{\partial A_N} = \frac{\alpha(1-\gamma)}{1-\alpha} \Psi_1 A_T^{\frac{1-\alpha+\gamma\alpha}{1-\alpha}} A_N^{\frac{\alpha-\alpha\gamma-1+\alpha}{1-\alpha}} + \frac{1-\alpha\gamma}{1-\alpha} \Psi_2 A_T^{\frac{\gamma\alpha}{1-\alpha}} A_N^{\frac{\alpha-\alpha\gamma}{1-\alpha}} > 0,$$

where

$$\begin{aligned} \Psi_1 &= \left(\gamma \frac{\delta\alpha}{r+\delta} + \varepsilon \left(1 - \frac{\delta\alpha}{r+\delta} \right) \right) \left(\frac{\alpha}{r+\delta} \right)^{\frac{\alpha}{1-\alpha}} L > 0, \\ \Psi_2 &= \left((1-\gamma) \frac{\delta\alpha}{r+\delta} + (1-\varepsilon) \left(1 - \frac{\delta\alpha}{r+\delta} \right) \right) \left(\frac{\alpha}{r+\delta} \right)^{\frac{\alpha}{1-\alpha}} L \frac{\widetilde{A}_T}{\widetilde{A}_N} > 0. \end{aligned}$$

PPP adjusted output is positively related to changes in either of the productivity parameters. With respect to changes in relative productivity, A_T/A_N, there is no clear relation, since it depends on the sign of the change in the level of A_T and A_N. For example, if only A_N or only A_T increases, then output will increase, but relative productivity move in opposite directions in the two scenarios.

The PPP adjusted investment ratio can be expressed as

$$\frac{I^{PPP}}{Y^{PPP}} = \frac{\frac{\alpha\delta}{r+\delta} \left[1 - \gamma \left(1 - \frac{A_T}{A_N} / \frac{\widetilde{A}_T}{\widetilde{A}_N} \right) \right]}{1 - \left[\gamma \frac{\alpha\delta}{r+\delta} + \varepsilon \left(1 - \frac{\alpha\delta}{r+\delta} \right) \right] \left(1 - \frac{A_T}{A_N} / \frac{\widetilde{A}_T}{\widetilde{A}_N} \right)}.$$

We are interested in the sign of

$$\frac{\partial \frac{I^{PPP}}{Y^{PPP}}}{\partial \frac{A_T}{A_N}} = \frac{(\gamma - \varepsilon) \frac{\delta\alpha}{r+\delta} \left(1 - \frac{\delta\alpha}{r+\delta}\right) \frac{\widetilde{A}_T}{\widetilde{A}_N}}{\left[1 - \left[\gamma \frac{\alpha\delta}{r+\delta} + \varepsilon \left(1 - \frac{\alpha\delta}{r+\delta}\right)\right] \left(1 - \frac{A_T}{A_N} / \frac{\widetilde{A}_T}{\widetilde{A}_N}\right)\right]^2},$$

which is positive if $\gamma > \varepsilon$ and negative if $\gamma < \varepsilon$.

B.3 CES aggregation in consumption

This is a simple extension of the model's steady state solution. Instead of the unitary elasticity of substitution for traded and nontraded goods in consumption, we now allow for a more general functional form

$$F_C(c_{Tt}, c_{Nt}) = \left(\mu c_{Tt}^{\frac{\theta-1}{\theta}} + (1-\mu)\, c_{Nt}^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}},$$

where θ represents the intratemporal elasticity of substitution and μ is a weight parameter. In this case, all steady state solutions above are still valid, subject to the following substitution

$$\varepsilon = \left(\left(\frac{A_T}{A_N}\right)^{1-\theta} \left(\frac{\mu}{1-\mu}\right)^{\theta} + 1\right)^{-1}.$$

Table 1: Investment expenditures on the output of different sectors of economic activity, as a fraction of total expenditures

Country	Sector of economic activity	Pre-1973	Mid/late-1970s	Early-1980s	Mid-1980s	1990	Country average
Australia	Manufacturing	0.31	0.27		0.32	0.27	0.29
	Construction	0.54	0.62		0.56	0.62	0.58
	Retail/wholesale trade	0.07	0.06		0.07	0.06	0.06
	Real est./bus. services	0.02	0.02		0.04	0.02	0.02
	Other	0.06	0.03		0.01	0.03	0.04
Canada	Manufacturing	0.34	0.38	0.39	0.42	0.39	0.38
	Construction	0.59	0.54	0.54	0.51	0.53	0.54
	Retail/wholesale trade	0.05	0.06	0.06	0.06	0.07	0.06
	Real est./bus. services	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.01	0.02	0.01	0.01	0.01	0.01
Denmark	Manufacturing	0.26	0.33	0.33	0.41	0.40	0.35
	Construction	0.67	0.60	0.60	0.49	0.50	0.57
	Retail/wholesale trade	0.05	0.05	0.06	0.07	0.07	0.06
	Real est./bus. services	0.02	0.02	0.02	0.02	0.03	0.02
	Other	0.00	0.00	0.00	0.00	0.00	0.00
France	Manufacturing	0.32	0.32	0.48	0.51	0.51	0.43
	Construction	0.61	0.61	0.47	0.44	0.43	0.51
	Retail/wholesale trade	0.03	0.03	0.03	0.03	0.03	0.03
	Real est./bus. services	0.00	0.00	0.01	0.01	0.01	0.01
	Other	0.04	0.04	0.01	0.00	0.01	0.02
Germany	Manufacturing		0.42	0.47	0.49	0.50	0.47
	Construction		0.49	0.46	0.44	0.43	0.45
	Retail/wholesale trade		0.05	0.03	0.03	0.03	0.04
	Real est./bus. services		0.03	0.03	0.03	0.03	0.03
	Other		0.00	0.01	0.01	0.01	0.01
Italy	Manufacturing			0.39			0.39
	Construction			0.52			0.52
	Retail/wholesale trade			0.05			0.05
	Real est./bus. services			0.02			0.02
	Other			0.02			0.02
Japan	Manufacturing	0.36	0.28	0.26	0.34	0.31	0.31
	Construction	0.57	0.66	0.67	0.59	0.59	0.62
	Retail/wholesale trade	0.07	0.06	0.06	0.06	0.08	0.06
	Real est./bus. services	0.00	0.00	0.00	0.00	0.01	0.00
	Other	0.01	0.01	0.01	0.01	0.01	0.01
Netherlands	Manufacturing	0.32	0.34	0.32	0.42		0.35
	Construction	0.54	0.49	0.51	0.41		0.49
	Retail/wholesale trade	0.06	0.06	0.06	0.08		0.06
	Real est./bus. services	0.05	0.08	0.07	0.07		0.07
	Other	0.03	0.03	0.03	0.02		0.03
UK	Manufacturing	0.43	0.47		0.44	0.40	0.43
	Construction	0.46	0.38		0.48	0.47	0.45
	Retail/wholesale trade	0.01	0.04		0.02	0.04	0.03
	Real est./bus. services	0.06	0.05		0.05	0.08	0.06
	Other	0.04	0.05		0.02	0.01	0.03
USA	Manufacturing	0.37	0.39	0.37	0.39	0.39	0.38
	Construction	0.54	0.48	0.52	0.50	0.46	0.50
	Retail/wholesale trade	0.05	0.08	0.07	0.07	0.07	0.07
	Real est./bus. services	0.02	0.03	0.02	0.02	0.04	0.03
	Other	0.02	0.02	0.02	0.02	0.04	0.02
Period average	Manufacturing	0.34	0.36	0.38	0.41	0.40	0.38
	Construction	0.56	0.54	0.54	0.49	0.50	0.52
	Retail/wholesale trade	0.05	0.05	0.05	0.06	0.06	0.05
	Real est./bus. services	0.02	0.02	0.02	0.03	0.03	0.03
	Other	0.03	0.02	0.01	0.01	0.01	0.02

Data source: OECD (2000a). The exact years of coverage for each country are: Australia - 1968, 1974, 1986, 1989; Canada - 1971, 1976, 1981, 1986, 1990; Denmark - 1972, 1977, 1980, 1985, 1990; France - 1972, 1977, 1980, 1985, 1990; Germany - 1978, 1986, 1988, 1990; Italy - 1985; Japan - 1970, 1975, 1980, 1985, 1990; Netherlands - 1972, 1977, 1981, 1986; UK - 1968,1979, 1984, 1990; United States - 1972, 1977, 1982, 1985, 1990.

Table 2: Investment expenditures on nontraded goods, as a fraction of total expenditures (OECD data, 1970-2002)

Country	Coverage	Number of obs.	Mean	Standard deviation	Max	Min	Max-Min
AUSTRIA	1976-2002	27	0.585	0.020	0.62	0.56	0.06
CANADA	1981-2002	22	0.689	0.033	0.72	0.63	0.10
DENMARK	1970-2002	33	0.570	0.059	0.69	0.49	0.20
FINLAND	1970-2002	33	0.619	0.025	0.67	0.57	0.10
FRANCE	1978-2002	25	0.590	0.033	0.65	0.54	0.10
GERMANY	1970-2002	33	0.613	0.032	0.67	0.55	0.12
GREECE	1995-2002	8	0.620	0.027	0.67	0.59	0.08
ICELAND	1990-2002	13	0.647	0.042	0.71	0.56	0.15
IRELAND	1990-2002	13	0.629	0.047	0.72	0.56	0.17
ITALY	1970-2002	33	0.523	0.035	0.59	0.46	0.13
JAPAN	1990-2001	12	0.598	0.019	0.64	0.58	0.06
LUXEMBOURG	1986-2002	17	0.560	0.040	0.62	0.51	0.11
NETHERLANDS	1970-2002	33	0.625	0.036	0.69	0.56	0.13
NEW ZEALAND	1971-2001	31	0.539	0.036	0.59	0.47	0.13
NORWAY	1970-2002	33	0.665	0.048	0.76	0.55	0.20
PORTUGAL	1988-2002	15	0.578	0.028	0.62	0.52	0.10
SPAIN	1980-2002	23	0.635	0.034	0.70	0.58	0.12
SWEDEN	1993-2002	10	0.463	0.050	0.57	0.40	0.17
SWITZERLAND	1990-2001	12	0.561	0.033	0.61	0.51	0.09
UNITED KINGDOM	1970-2002	33	0.511	0.027	0.57	0.46	0.11
UNITED STATES	1970-2002	33	0.588	0.030	0.65	0.54	0.12
Average			0.591	0.035	0.654	0.533	0.121

Data source: OECD (2004).

Table 3: Investment expenditures on nontraded goods, as a fraction of total expenditures (UN data, 1950-1997)

Country	Coverage	Number of obs.	Mean	Standard deviation	Max	Min	Max-Min
Algeria	1970-83	14	0.536	0.048	0.63	0.46	0.17
Angola	1985-90	6	0.453	0.032	0.50	0.40	0.10
Australia	1959-96	38	0.535	0.021	0.60	0.49	0.11
Austria	1954-96	43	0.540	0.024	0.58	0.47	0.11
Azerbaijan	1994-96	3	0.732	0.046	0.76	0.68	0.08
Bahamas	1989-92	4	0.343	0.007	0.35	0.33	0.02
Bangladesh	1972-87	16	0.633	0.076	0.79	0.52	0.27
Belgium	1960-97	38	0.592	0.050	0.68	0.49	0.18
Bermuda	1979-92	14	0.524	0.055	0.66	0.42	0.24
Bhutan	1980-96	17	0.576	0.132	0.79	0.40	0.39
Bolivia	1960-69, 88-92	15	0.484	0.071	0.61	0.36	0.24
Botswana	1971,73-89,91-91	20	0.556	0.107	0.73	0.42	0.31
Brazil	1980-84	10	0.680	0.025	0.72	0.64	0.08
Brunei Darussalam	1974-84	11	0.833	0.065	0.92	0.74	0.19
Cambodia	1993-96	4	0.726	0.075	0.83	0.66	0.17
Cameroon	1971-88	18	0.557	0.053	0.69	0.48	0.20
Canada	1950-97	48	0.680	0.025	0.73	0.63	0.11
Cape Verde	1980-89	10	0.657	0.035	0.70	0.59	0.11

Table 3: continued

Country	Coverage	Number of obs.	Mean	Standard deviation	Max	Min	Max-Min
Chile	1974-96	23	0.568	0.070	0.74	0.47	0.28
Hong Kong	1961-97	37	0.395	0.041	0.50	0.30	0.20
Colombia	1960-95	36	0.575	0.041	0.66	0.49	0.17
Cote d'Ivoire	1970-82	13	0.639	0.041	0.71	0.58	0.13
Croatia	1994-96	3	0.590	0.026	0.62	0.57	0.05
Cyprus	1960-96	37	0.649	0.059	0.74	0.53	0.21
Czech Republic	1987-91	5	0.587	0.035	0.63	0.55	0.08
Denmark	1966-95	30	0.603	0.066	0.70	0.49	0.20
Dominica	1971,73,78-91	16	0.518	0.092	0.68	0.39	0.29
Ecuador	1970-93	24	0.546	0.073	0.68	0.42	0.25
Egypt	1960-79	20	0.460	0.031	0.51	0.42	0.09
El Salvador	1963-89	27	0.442	0.061	0.60	0.35	0.24
Equatorial Guinea	1985-91	7	0.429	0.121	0.64	0.29	0.35
Ethiopia [up to 1993]	1970-75	6	0.675	0.019	0.71	0.65	0.05
Fiji	1970-72	3	0.544	0.022	0.57	0.52	0.04
Finland	1960-96	37	0.623	0.028	0.68	0.55	0.13
France	1970-97	28	0.587	0.035	0.65	0.54	0.11
Gabon	1974	1	0.633		0.63	0.63	0.00
Gambia	1970-71,74,93	22	0.645	0.132	0.86	0.38	0.49
Germany	1991-97	7	0.609	0.041	0.64	0.53	0.11
Federal Republic of Germany	1960-94	35	0.610	0.035	0.66	0.53	0.13
Ghana	1955-85	31	0.682	0.060	0.81	0.57	0.24
Greece	1960-95	36	0.626	0.050	0.72	0.53	0.19
Guadeloupe	1965-69	5	0.658	0.029	0.70	0.63	0.07
Guatemala	1950-96	48	0.412	0.115	0.67	0.26	0.41
Iceland	1960-96	37	0.719	0.045	0.82	0.62	0.20
India	1950-96	47	0.561	0.078	0.75	0.42	0.33
Iran (Islamic Republic of)	1965-95	31	0.672	0.091	0.84	0.50	0.34
Iraq	1970-75,87-89	9	0.644	0.087	0.78	0.55	0.23
Ireland	1970-96	27	0.533	0.047	0.64	0.45	0.19
Israel	1950-97	48	0.611	0.089	0.83	0.43	0.39
Italy	1960-97	38	0.558	0.047	0.65	0.48	0.17
Jamaica	1974-90	17	0.518	0.050	0.63	0.43	0.20
Japan	1970-96	27	0.631	0.030	0.67	0.57	0.11
Jordan	1959-96	38	0.698	0.086	0.87	0.51	0.36
Kazakhstan	1990-96	7	0.894	0.048	0.93	0.82	0.12
Kenya	1970-95	26	0.473	0.073	0.59	0.24	0.34
Kuwait	1970-81	12	0.555	0.098	0.68	0.37	0.31
Kyrgyzstan	1990-96	7	0.967	0.027	0.99	0.91	0.08
Lesotho	1964-96	32	0.655	0.125	0.89	0.45	0.44
Libyan Arab Jamahiriya	1971-79	9	0.666	0.016	0.69	0.64	0.05
Luxembourg	1970-79	10	0.641	0.051	0.72	0.58	0.15
Malawi	1970-72	3	0.443	0.044	0.49	0.41	0.08
Malaysia	1960-71,73,78,83	15	0.630	0.080	0.72	0.51	0.21
Malta	1970-97	28	0.372	0.079	0.57	0.27	0.31
Mauritius	1970-97	28	0.573	0.070	0.70	0.40	0.29
Mexico	1970-96	27	0.554	0.033	0.60	0.49	0.11
Montserrat	1975-86	12	0.598	0.075	0.74	0.49	0.25
Morocco	1960-69	10	0.597	0.026	0.64	0.55	0.09
Namibia	1987-96	10	0.630	0.056	0.72	0.52	0.20
Nepal	1977-81	5	0.755	0.033	0.79	0.71	0.08
Netherlands	1969-97	29	0.568	0.039	0.64	0.51	0.13
New Zealand	1971-96	26	0.534	0.037	0.59	0.47	0.13

Table 3: continued

Country	Coverage	Number of obs.	Mean	Standard deviation	Max	Min	Max-Min
Nicaragua	1970-78	9	0.426	0.045	0.50	0.37	0.12
Nigeria	1974-94	21	0.521	0.171	0.75	0.21	0.53
Norway	1960-96	37	0.586	0.056	0.66	0.47	0.19
Oman	1981-95	15	0.788	0.052	0.86	0.68	0.18
Pakistan	1975-89	15	0.498	0.073	0.64	0.43	0.22
Panama	1950-79	30	0.580	0.047	0.66	0.49	0.17
Paraguay	1962-94	33	0.538	0.086	0.78	0.43	0.35
Peru	1970-97	28	0.639	0.093	0.78	0.48	0.30
Philippines	1950-97	48	0.537	0.083	0.71	0.37	0.34
Portugal	1970-95	25	0.526	0.050	0.65	0.45	0.20
Puerto Rico	1950-96	47	0.631	0.072	0.76	0.50	0.26
Republic of Korea	1960-97	38	0.591	0.057	0.69	0.50	0.19
Saint Kitts and Nevis	1973,75	2	0.340	0.045	0.37	0.31	0.06
Saint Vincent and the Grenadines	1977-97	21	0.663	0.072	0.77	0.49	0.28
Saudi Arabia	1963-97	16	0.743	0.031	0.83	0.71	0.11
Seychelles	1976-90	15	0.506	0.114	0.64	0.27	0.36
Sierra Leone	1970-90	21	0.554	0.067	0.70	0.41	0.29
Singapore	1970-97	28	0.474	0.075	0.63	0.39	0.24
Slovenia	1990-95	6	0.463	0.048	0.54	0.42	0.13
South Africa	1963-97	48	0.528	0.057	0.60	0.39	0.22
Spain	1980-96	17	0.672	0.028	0.73	0.63	0.10
Sri Lanka	1963-97	35	0.607	0.086	0.74	0.41	0.33
Sudan	1970-83	14	0.456	0.100	0.66	0.31	0.35
Suriname	1975-94	20	0.570	0.100	0.76	0.36	0.40
Sweden	1970-96	27	0.583	0.051	0.67	0.46	0.21
Switzerland	1950-96	47	0.609	0.046	0.68	0.53	0.15
Syrian Arab Republic	1963-97	35	0.591	0.111	0.81	0.40	0.41
Thailand	1960-96	37	0.517	0.055	0.60	0.40	0.20
Togo	1970-72	3	0.542	0.044	0.59	0.50	0.09
Tonga	1975-83	9	0.655	0.069	0.77	0.57	0.20
Trinidad and Tobago	1966-94	29	0.414	0.091	0.63	0.27	0.36
Tunisia	1962-69	8	0.650	0.030	0.71	0.62	0.09
Turkey	1960-97	38	0.613	0.064	0.75	0.50	0.25
Uganda	1970-76,81-95	22	0.617	0.060	0.73	0.47	0.26
United Kingdom	1963-96	34	0.537	0.021	0.59	0.50	0.09
United Republic of Tanzania	1970-94	25	0.412	0.141	0.67	0.20	0.47
United States	1960-97	38	0.587	0.040	0.66	0.52	0.15
Uruguay	1966-89	24	0.690	0.076	0.82	0.58	0.24
Venezuela	1970-95	26	0.556	0.035	0.64	0.49	0.15
Yugoslavia	1974	1	0.744		0.74	0.74	0.00
Zambia	1970-91	22	0.408	0.095	0.52	0.22	0.29
Zimbabwe	1970-89	20	0.524	0.079	0.63	0.34	0.30

Data source: UN (2001a, b).

Table 4: Time trends in investment expenditures on nontraded goods for sample countries with at least 30 years of data*

Country	Coverage	# of obs.	Time trend, per decade	Newey-West standard error	t-statistic	Lower 95%	Upper 95 %
			Panel 1: OECD data				
Denmark	1970-2002	33	-0.053	0.010	-5.97	-0.07	-0.03
Finland	1970-2002	33	0.002	0.007	0.27	-0.01	0.02
Germany	1970-2002	33	-0.009	0.008	-1.16	-0.02	0.01
Italy	1970-2002	33	-0.025	0.007	-3.38	-0.04	-0.01
Netherlands	1970-2002	33	-0.019	0.008	-2.50	-0.04	0.00
New Zealand	1971-2001	31	-0.006	0.006	-0.97	-0.02	0.01
Norway	1970-2002	33	0.030	0.012	2.61	0.01	0.06
United Kingdom	1970-2002	33	-0.011	0.007	-1.71	-0.02	0.00
United States	1970-2002	33	-0.027	0.005	-5.16	-0.04	-0.02
			Panel 2: UN data, OECD countries				
Australia	1959-1996	38	-0.006	0.004	-1.42	-0.01	0.00
Austria	1954-1996	43	0.015	0.005	2.83	0.00	0.03
Belgium	1960-1997	38	-0.026	0.010	-2.55	-0.05	-0.01
Canada	1950-1997	48	-0.009	0.005	-1.73	-0.02	0.00
Denmark	1966-1995	30	-0.070	0.007	-10.32	-0.08	-0.06
Finland	1960-1996	37	-0.008	0.008	-1.06	-0.02	0.01
Fed. Rep. of Germany	1960-1994	35	-0.025	0.007	-3.53	-0.04	-0.01
Greece	1960-1995	36	-0.043	0.003	-15.70	-0.05	-0.04
Iceland	1960-1996	37	-0.009	0.008	-1.08	-0.03	0.01
Italy	1960-1997	38	-0.032	0.009	-3.79	-0.05	-0.02
Norway	1960-1996	35	0.046	0.009	5.00	0.03	0.06
Republic of Korea	1960-1997	38	-0.004	0.015	-0.25	-0.03	0.03
Switzerland	1950-1996	47	-0.022	0.006	-3.72	-0.03	-0.01
Turkey	1960-1997	38	-0.018	0.012	-1.42	-0.04	0.01
United Kingdom	1963-1996	34	-0.003	0.005	-0.73	-0.01	0.01
United States	1960-1997	38	-0.034	0.003	-11.47	-0.04	-0.03
			Panel 3: UN data, non-OECD countries				
Hong Kong	1961-1997	37	0.000	0.006	-0.05	-0.02	0.02
Colombia	1960-1995	36	-0.022	0.005	-3.37	-0.03	-0.01
Cyprus	1960-1996	37	0.041	0.006	7.32	0.03	0.05
Ghana	1955-1985	31	-0.013	0.013	-0.86	-0.05	0.02
Guatemala	1950-1996	47	-0.065	0.007	-5.07	-0.09	-0.04
India	1950-1996	47	-0.053	0.003	-12.34	-0.06	-0.04
Islamic Rep. of Iran	1965-1995	31	0.006	0.020	0.19	-0.06	0.08
Israel	1950-1997	48	-0.052	0.006	-5.09	-0.07	-0.03
Jordan	1959-1996	38	0.007	0.011	0.39	-0.03	0.04
Lesotho	1964-1996	32	0.093	0.021	4.36	0.05	0.14
Panama	1950-1979	30	0.000	0.009	0.03	-0.03	0.03
Paraguay	1962-1994	33	0.040	0.014	2.01	0.00	0.08
Philippines	1950-1997	48	-0.032	0.006	-3.11	-0.05	-0.01
Puerto Rico	1950-1996	47	-0.037	0.005	-3.50	-0.06	-0.02
South Africa	1963-1997	48	-0.036	0.003	-6.93	-0.05	-0.03
Sri Lanka	1963-1997	35	-0.059	0.006	-6.95	-0.08	-0.04
Syrian Arab Republic	1963-1997	35	-0.003	0.017	-0.10	-0.07	0.06
Thailand	1960-1996	37	-0.009	0.007	-0.71	-0.03	0.02
Uruguay	1966-1989	30	0.061	0.030	1.43	-0.03	0.15

Data sources: OECD (2004), UN (2001a, b).

* The time trend reports the estimate of 10*β from the regression: $\gamma_t = \alpha+\beta t+\varepsilon_t$, where t denotes years. The test statistic is a t-statistic corresponding to Newey-West corrected standard error and tests β=0. Note that the slope of expenditure shares is multiplied by 10 and should therefore be interpreted as a change in expenditure share over a decade. The N-W standard error and 95% bounds are also multiplied by 10.

Table 5: Pooled time trends for sample countries with at least 30 years of data*

Type of regression	Sample	# of obs.	Time trend, per decade	Standard error	t-statistic	Lower 95%	Upper 95 %
	Panel 1: OECD data						
Pooled OLS	OECD countries	295	-0.013	0.004	-3.60	-0.021	-0.006
Panel with country dummies	OECD countries	295	-0.013	0.002	-6.04	-0.018	-0.009
	Panel 2: UN data						
Pooled OLS	all countries	1335	-0.014	0.002	-6.65	-0.019	-0.010
	OECD countries	610	-0.014	0.002	-6.26	-0.019	-0.010
	Non-OECD countries	725	-0.016	0.003	-4.65	-0.023	-0.009
Panel with country dummies	all countries	1335	-0.017	0.002	-10.81	-0.020	-0.014
	OECD countries	610	-0.012	0.001	-8.37	-0.015	-0.010
	Non-OECD countries	725	-0.020	0.003	-7.96	-0.025	-0.015

Data sources: OECD (2004), UN (2001a, b).

* See notes to Table 4. In case of country dummies, the time trend reports the estimate of 10*β from the regression: $\gamma_t = \alpha+\beta t+d_i+\varepsilon_t$, where d_i is a country dummy.

Table 6: Correlation between nontraded expenditure shares

# of countries included	Period	1950-59	1960-69	1970-79	1980-89	1990-97
13	1950-59	1				
44	1960-69	0.649	1			
91	1970-79	0.452	0.863	1		
91	1980-89	0.527	0.555	0.643	1	
80	1990-97	0.307	0.630	0.492	0.735	1

Data sources: UN (2001a, b).

Table 7: Cross-section comparison of investment expenditures on nontraded goods (UN data)

Year	# of countries included	Mean	Corr with real income per capita
1950	9	0.68	-0.31
1951	9	0.68	-0.13
1952	9	0.65	-0.21
1953	9	0.64	-0.12
1954	10	0.62	0.22
1955	11	0.63	0.15
1956	11	0.63	0.15
1957	11	0.62	0.14
1958	11	0.62	0.10
1959	13	0.61	0.04
1960	30	0.60	0.07
1961	31	0.60	0.12
1962	33	0.60	0.09
1963	37	0.60	0.06
1964	38	0.60	0.07
1965	40	0.60	0.10
1966	42	0.60	0.14
1967	43	0.59	0.14
1968	43	0.59	0.18
1969	44	0.58	0.27
1970	71	0.56	0.28
1971	76	0.56	0.32
1972	73	0.58	0.26
1973	74	0.58	0.23
1974	77	0.59	0.19
1975	81	0.57	0.28
1976	78	0.57	0.25
1977	79	0.57	0.19
1978	81	0.56	0.30
1979	80	0.58	0.24
1980	80	0.59	0.08
1981	82	0.60	-0.01
1982	80	0.60	-0.03
1983	80	0.60	0.01
1984	76	0.58	0.06
1985	77	0.57	0.02
1986	76	0.55	0.14
1987	79	0.55	0.18
1988	79	0.54	0.15
1989	79	0.54	0.13
1990	74	0.54	0.26
1991	72	0.55	0.16
1992	68	0.56	0.16
1993	65	0.57	0.11
1994	66	0.56	0.00
1995	59	0.57	-0.15
1996	48	0.58	-0.23
1997	21	0.52	0.08

Data sources: UN (2001a, b).

Table 8: Cross-section comparison of investment expenditures on nontraded goods (PWT benchmark data)

Data set	# of countries included	Mean	Correlation with real income per capita
PWT 1996 benchmark*	115	0.51	0.12
-only A,B	*33*	*0.56*	*0.03*
-only A	*18*	*0.56*	*0.10*
Nehru-Dhareshwar dataset, 1987	42	0.56	0.13
PWT 1985 benchmark	65	0.56	0.04
PWT 1980 benchmark	60	0.58	0.31
PWT 1975 benchmark	34	0.57	0.53
PWT 1970 benchmark	16	0.56	0.13

* A, B, C and D refer to data quality, with A representing the highest and D the lowest quality. See Penn World Table 6.1 benchmark for details.

Table 9: Investment expenditure share on nontraded goods by region, (PWT 1996 benchmark data)

Region	# of countries included	Mean	Correlation with real income per capita
Western Europe and North America*	25	0.56	-0.02
Africa	22	0.23	0.00
-Africa, PWT 1985	*22*	*0.54*	*-0.10*
-Africa, PWT 1980	*15*	*0.57*	*0.29*
Eastern and Central Europe	14	0.54	0.54
Asia	12	0.59	0.19
Oceania	12	0.51	0.12
Former Soviet Union, excl. Baltics	12	0.66	0.32
Latin America	10	0.57	-0.26
Middle East	8	0.57	0.57

* Also includes Japan, Australia and New Zealand.

Table 10: Investment expenditure share on nontraded goods by region (UN data)

	Africa			Europe			Latin America			South East Asia		
Year	# of countries included	Mean	Corr. with real GDP per capita	# of countries included	Mean	Corr. with real GDP per capita	# of countries included	Mean	Corr. with real GDP per capita	# of countries included	Mean	Corr. with real GDP per capita
1960	4	0.56	0.18	10	0.60	-0.30	4	0.54	0.00	4	0.63	0.15
1961	4	0.59	-0.06	10	0.60	-0.24	4	0.51	0.45	5	0.58	-0.67
1962	5	0.63	-0.26	10	0.60	-0.24	5	0.50	0.43	5	0.58	-0.68
1963	5	0.60	-0.32	11	0.60	-0.29	6	0.51	-0.31	6	0.60	-0.66
1964	6	0.61	-0.49	11	0.62	-0.34	6	0.49	-0.43	6	0.60	-0.66
1965	6	0.59	-0.43	11	0.63	-0.29	6	0.46	-0.25	6	0.61	-0.69
1966	5	0.59	-0.19	12	0.63	-0.14	7	0.54	0.76	6	0.57	-0.67
1967	6	0.61	-0.27	12	0.63	-0.17	7	0.52	0.30	6	0.57	-0.67
1968	6	0.59	-0.24	12	0.64	-0.26	7	0.51	0.65	6	0.55	-0.76
1969	6	0.58	0.15	13	0.64	-0.23	7	0.51	0.35	6	0.52	-0.86
1970	17	0.53	0.15	18	0.61	0.15	11	0.53	0.20	8	0.51	-0.20
1971	19	0.54	0.14	18	0.60	0.47	11	0.54	0.27	8	0.50	-0.10
1972	17	0.54	0.15	18	0.61	0.46	11	0.54	0.47	8	0.54	-0.27
1973	16	0.59	-0.29	18	0.61	0.68	11	0.53	0.58	9	0.53	-0.18
1974	19	0.58	-0.14	18	0.62	0.54	12	0.55	0.55	9	0.57	-0.17
1975	18	0.55	-0.18	18	0.62	0.44	13	0.51	0.51	9	0.56	-0.09
1976	17	0.56	-0.20	17	0.61	0.57	13	0.52	0.41	9	0.57	-0.18
1977	16	0.56	-0.16	18	0.60	0.43	13	0.51	0.28	10	0.59	-0.30
1978	16	0.52	-0.02	18	0.61	0.25	13	0.51	0.44	11	0.56	-0.16
1979	16	0.55	-0.06	18	0.61	0.55	12	0.55	0.57	10	0.56	-0.19
1980	15	0.58	-0.14	18	0.61	0.14	12	0.58	0.62	11	0.60	-0.34
1981	16	0.58	-0.36	18	0.60	0.23	12	0.58	0.48	11	0.62	-0.42
1982	16	0.60	-0.31	18	0.59	0.41	12	0.61	0.37	10	0.62	-0.18
1983	15	0.58	-0.20	18	0.59	0.30	12	0.63	0.08	11	0.63	0.20
1984	13	0.54	-0.27	18	0.58	0.22	12	0.60	0.39	10	0.64	-0.33
1985	15	0.54	-0.17	18	0.57	0.04	12	0.60	0.35	9	0.57	-0.19
1986	14	0.48	0.05	18	0.56	0.21	12	0.56	0.55	9	0.54	-0.22
1987	15	0.48	0.28	19	0.56	0.08	12	0.55	0.59	9	0.53	-0.38
1988	15	0.49	0.23	19	0.56	-0.03	13	0.54	0.39	8	0.50	-0.34
1989	14	0.49	0.13	19	0.56	-0.13	13	0.54	0.27	8	0.52	-0.40
1990	12	0.46	0.17	20	0.57	-0.13	10	0.51	0.10	8	0.52	-0.36
1991	11	0.51	0.22	21	0.57	-0.12	10	0.53	0.07	8	0.51	-0.10
1992	9	0.50	0.15	20	0.58	-0.21	10	0.53	0.06	8	0.51	-0.09
1993	8	0.49	0.11	20	0.58	0.19	9	0.56	0.13	9	0.54	-0.32
1994	7	0.49	0.08	22	0.58	0.07	8	0.54	0.07	9	0.53	-0.16
1995	5	0.56	-0.32	20	0.56	0.10	6	0.53	0.06	9	0.53	-0.21
1996	3	0.63		16	0.57	-0.15	4	0.53	0.06	9	0.53	-0.03
1997	1	0.40		6	0.54	0.24	2	0.52		5	0.51	0.01

Data sources: UN (2001a, b).

Table 11: Investment expenditures on nontraded goods in OECD countries (OECD data)

Year	# of countries included	Mean	Corr. with real income per capita
1970	8	0.60	0.56
1971	9	0.60	0.66
1972	9	0.61	0.62
1973	9	0.61	0.56
1974	9	0.61	0.43
1975	9	0.61	0.52
1976	10	0.60	0.60
1977	10	0.59	0.49
1978	11	0.60	0.30
1979	11	0.59	0.43
1980	12	0.60	0.34
1981	13	0.60	0.43
1982	13	0.60	0.38
1983	13	0.60	0.43
1984	13	0.60	0.41
1985	13	0.58	0.47
1986	14	0.58	0.25
1987	14	0.58	0.37
1988	15	0.58	0.35
1989	15	0.57	0.16
1990	19	0.59	0.20
1991	19	0.59	-0.11
1992	19	0.61	0.11
1993	20	0.61	-0.07
1994	20	0.60	0.03
1995	21	0.59	-0.09
1996	21	0.59	-0.06
1997	21	0.58	-0.20
1998	21	0.57	-0.07
1999	21	0.57	-0.18
2000	21	0.57	0.06
2001	21	0.58	
2002	18	0.61	

Data source: OECD (2004).

Table 12: Comparison of investment expenditures on nontraded goods with estimates in Burstein et al. (2004)

Country	Year	Real GDP/ capita	Burstein et al. (2003), construction	Burstein et al. (2003), all nontraded	UN data	OECD data	PWT 1996 benchmark data
Korea	1993	11940	0.540	0.601	0.666		0.646
Mexico	1990	7429	0.485	0.635	0.502		0.516
Brazil	1999	6909	0.674				0.669
Argentina	1997	11349	0.542	0.638			0.635
Australia	1995	22164	0.500	0.627	0.491		0.513
Canada	1990	22427	0.526	0.596	0.667	0.649	0.624
Chile	1996	8972	0.596	0.677	0.530		0.510
Denmark	1998	25495	0.457	0.587		0.457	0.448
Finland	1995	18852	0.458	0.564	0.568	0.524	0.540
France	1995	20142	0.485	0.562	0.547	0.485	0.561
Germany	1995	21049	0.494	0.546	0.643	0.640	0.633
Greece	1996	12751	0.647	0.711		0.602	0.602
Italy	1992	19810	0.498	0.586	0.527	0.498	0.608
Japan	1995	23361	0.573	0.653	0.645	0.552	0.649
Netherlands	1996	21431	0.432	0.532	0.525	0.544	0.551
Norway	1997	26178	0.346	0.458		0.653	0.566
Spain	1995	16296	0.564	0.638	0.701	0.572	0.678
UK	1998	21693	0.410	0.481		0.427	0.492
US	1997	30286	0.423	0.527	0.515	0.470	0.538
Average			0.508	0.590	0.579	0.544	0.578
Corr. with real per capita GDP			-0.69	-0.64	-0.01	-0.22	-0.29

Data sources: Burstein et al. (2004), UN (2001a), OECD (2004), Heston et al. (2002).

Table 13: Investment rates and prices in the PWT 1996 benchmark data

	Real GDP per worker relative to the US						
Variable	<5%	5%-10%	10%-15%	15%-20%	20%-25%	...	>75%
Number of countries	10	11	9	9	9		21
Average I/Y	0.14	0.22	0.22	0.22	0.22		0.20
Average $(I/Y)^{PPP}$	0.08	0.12	0.14	0.16	0.18		0.24
Average p_T	0.99	1.03	0.71	0.83	0.94		1.06
Average p_N*	0.59	0.60	0.49	0.50	0.45		1.42

Data sources: Heston et al. (2002).

* Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Dominica, Grenada, Jamaica, St. Kitts & Nevis, St. Lucia, St. Vincent & Grenadines, Trinidad &Tobago were excluded from the calculation of the price of nontraded goods, p_N, since each of these countries was an outlier with respect to the rest of the sample. The average value of p_N for these small Caribbean countries was 3.74.

Figure 1: Investment expenditure share on nontraded goods, cross-section averages

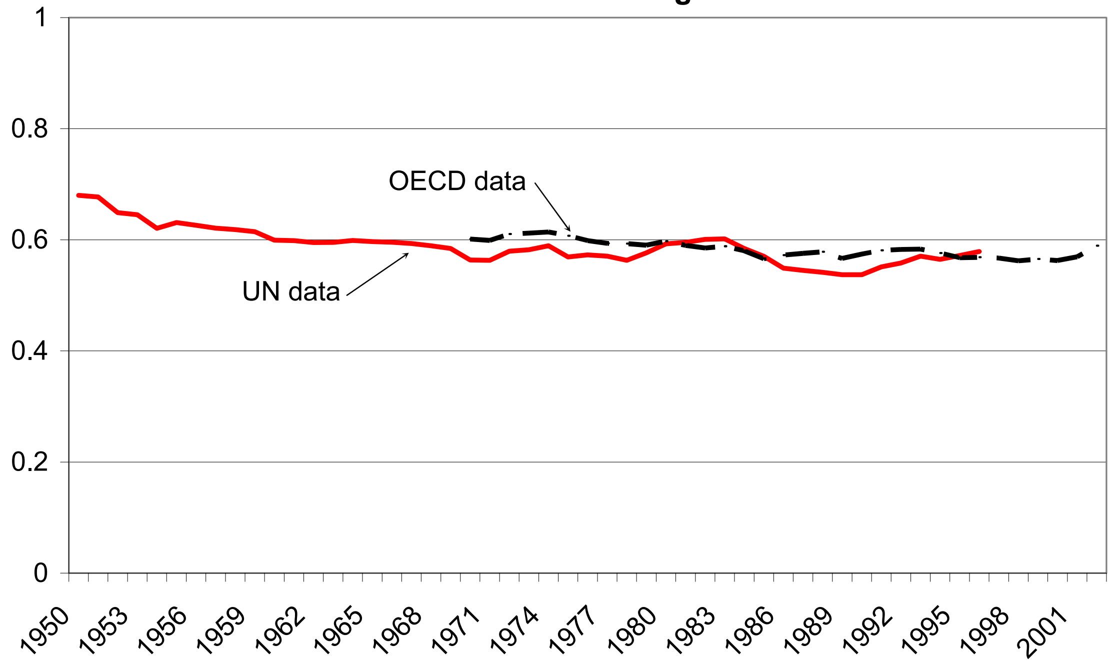

Figure 2: Investment expenditure share on nontraded goods in selected countries (OECD data)

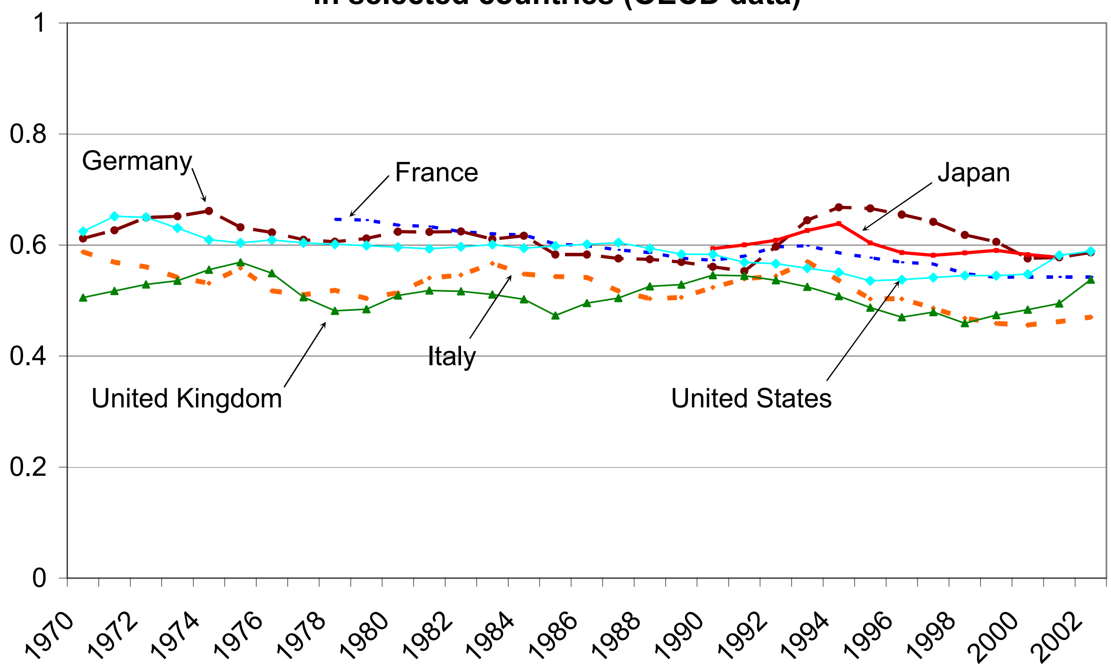

Figure 3: Investment expenditure share on nontraded goods (1996 PWT benchmark data)

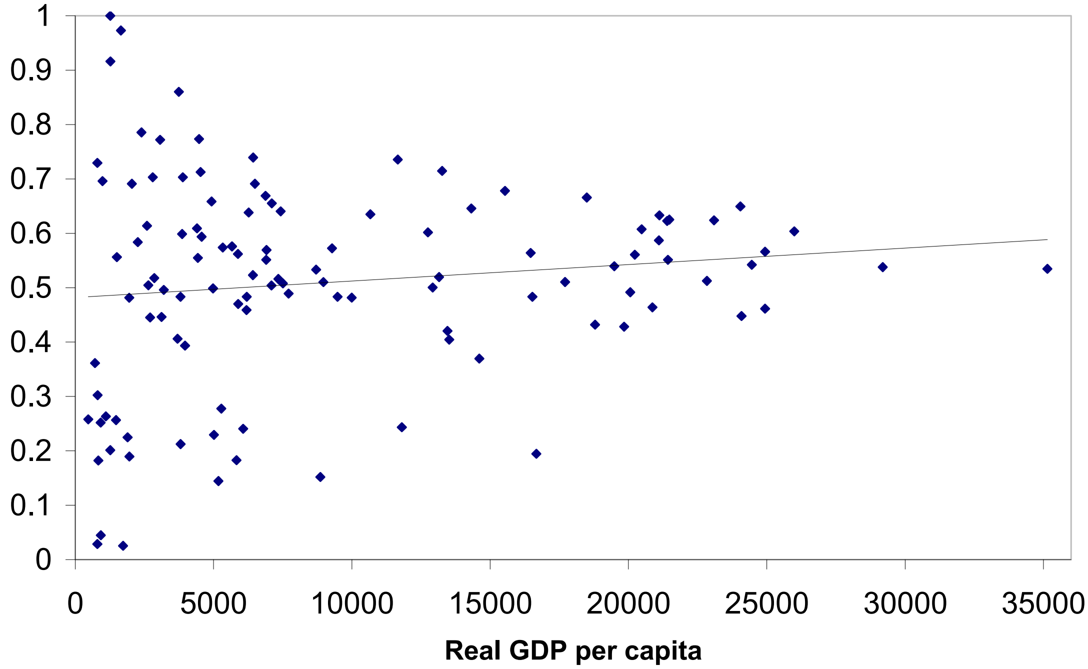

Figure 4: Investment expenditure share on nontraded goods (UN data, 1990)

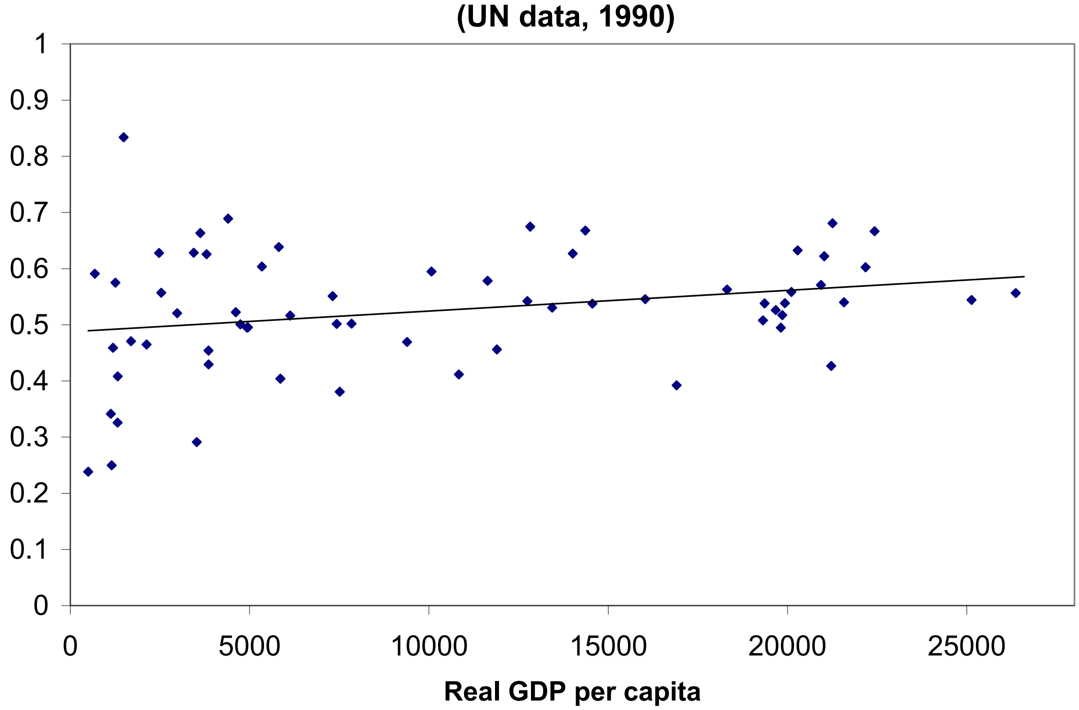

Figure 5: Investment expenditure share on nontraded goods (UN data, 1980)

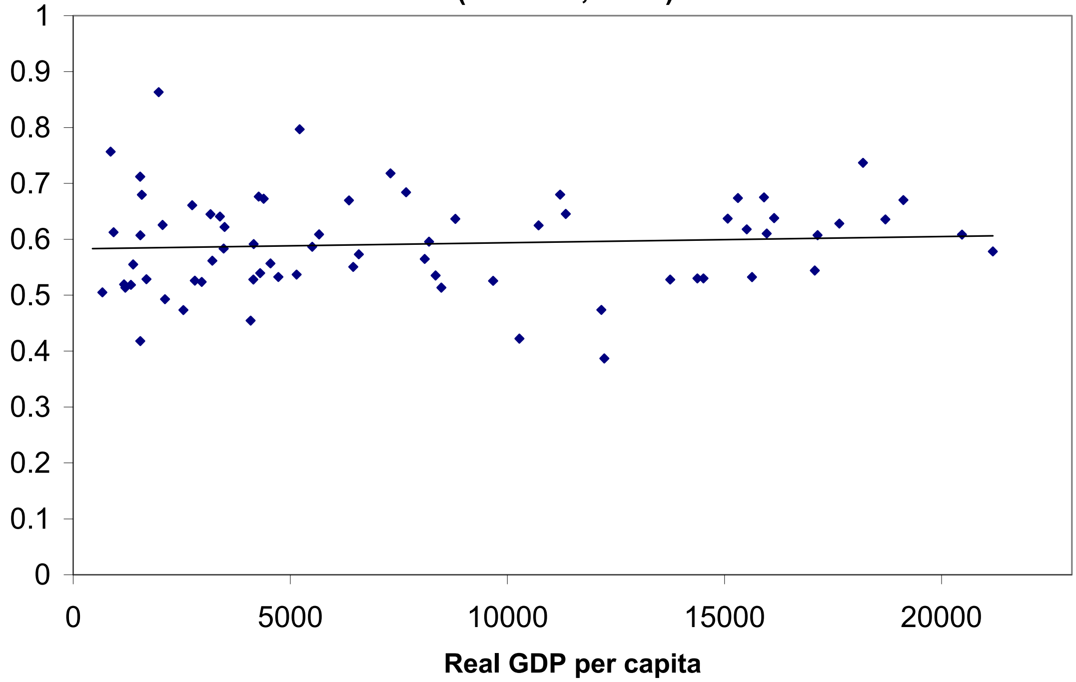

Figure 6: Investment expenditure share on nontraded goods (UN data, 1970)

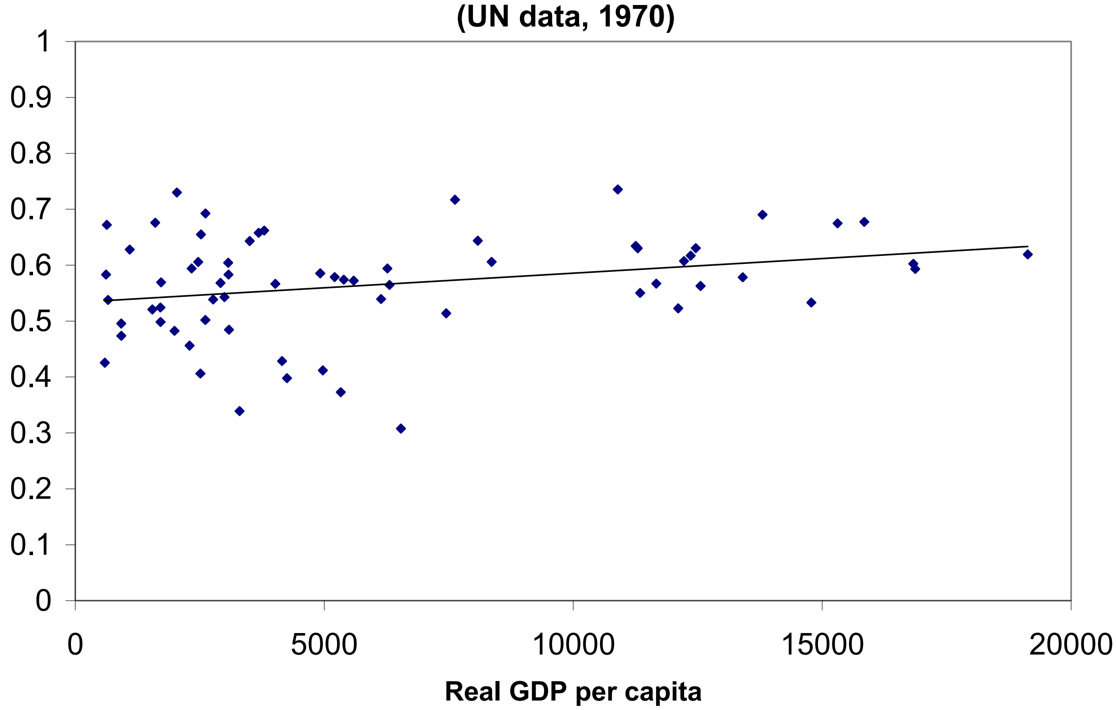

Figure 7: Investment expenditure share on nontraded goods (UN data, 1960)

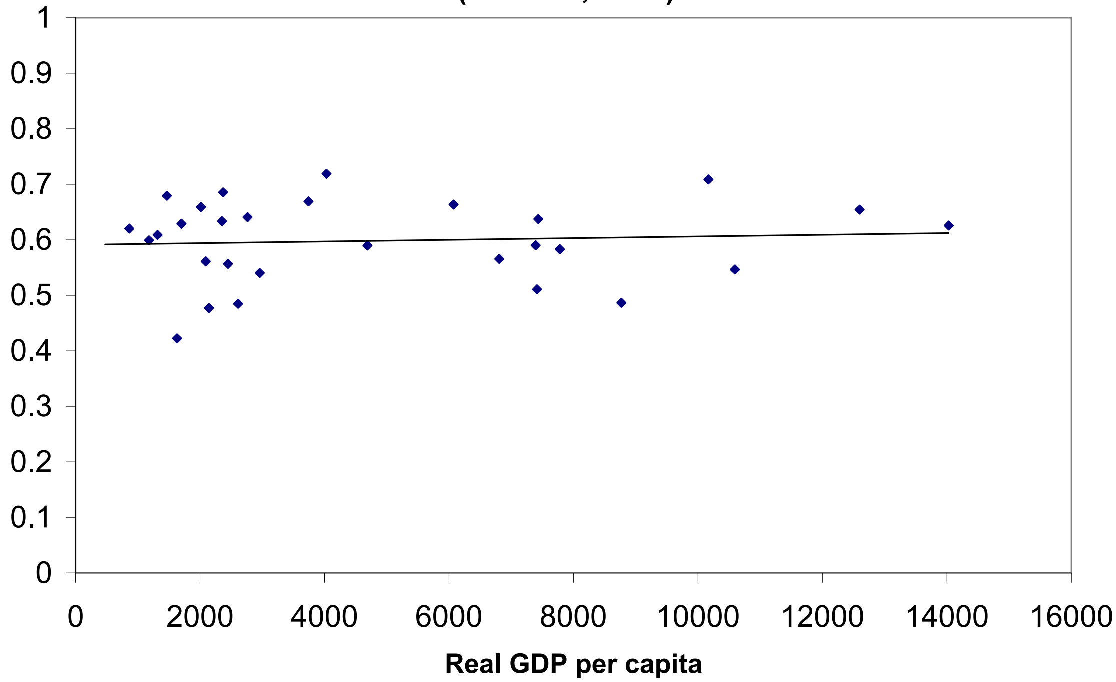

Figure 8: Investment expenditure share on nontraded goods for selected regions (UN data)

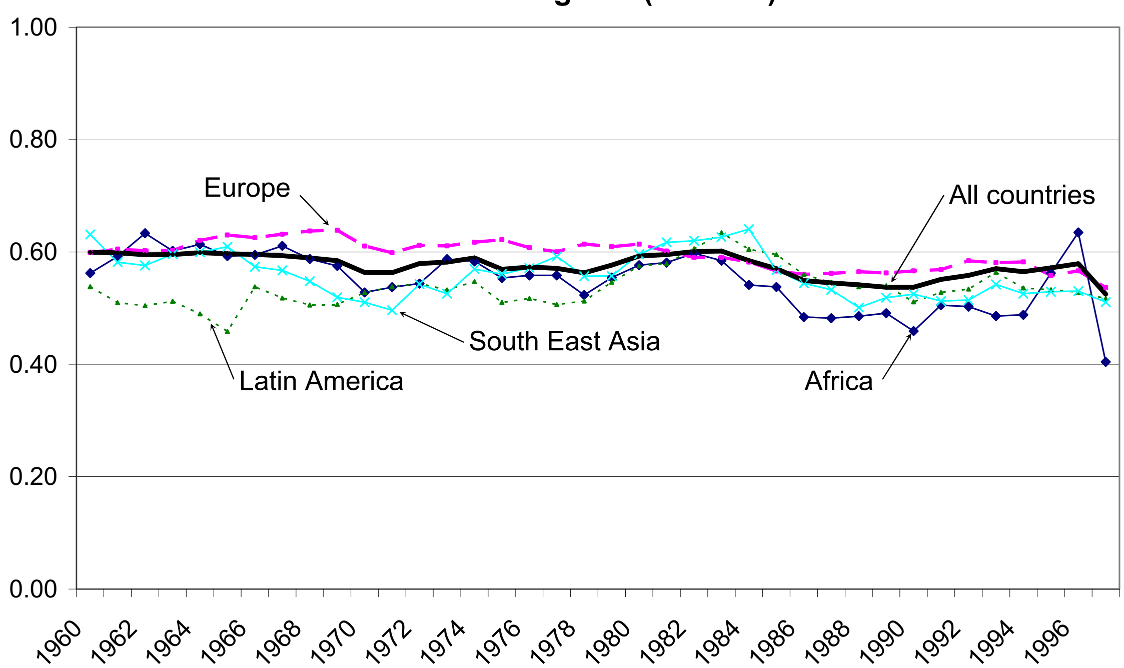

Figure 9: Variation in *international price* investment rates under different model specifications