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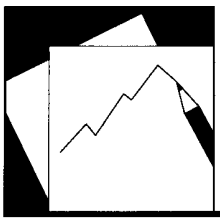

IMF Working Paper

International Competitiveness of the Mediterranean Quartet: A Heterogeneous-Product Approach

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International Competitiveness of the Mediterranean Quartet: A Heterogeneous-Product Approach*

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Abstract

The real effective exchange rate (REER) is the most commonly used measure for assessing international competitiveness. We develop a methodology to estimate the REER that incorporates two distinctive elements that are not considered in the current literature and apply it to the Mediterranean Quartet (MQ) of Greece, Italy, Portugal, and Spain, whose common pattern of real appreciation has created concern in policy and academic circles. The two elements that we add to the existing literature are (i) product heterogeneity when identifying each country's international competitors and their weights and (ii) a comprehensive treatment of services exports. Our refined measure suggests a modest reduction in the observed REER gap between the MQ countries and the other euro area countries. In particular, considering product heterogeneity and services exports implies a lower real appreciation from 1998 to 2006 on the order of 2-3 percent for all MQ countries. These are difference-in-difference estimates relative to the results obtained for the rest of the euro area countries using the same methodology.

JEL Classification Numbers: F10, F30

Keywords: International competitiveness, real effective exchange rate, product heterogeneity, industry level, structure of competitors, services exports, euro area.

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I. Introduction

In this paper, we develop a methodology to estimate the real effective exchange rate (REER) that incorporates two distinctive elements not accounted for in the current literature: (i) product heterogeneity when determining international competitors and their weights, which allows us to identify countries' direct international competitors more accurately, and (ii) a comprehensive treatment of services exports, which allows us to provide a complete view of international competitiveness encompassing the entire export sector.

We apply this methodology to reexamine the evolution of the REER of the Mediterranean Quartet (MQ) of Greece, Italy, Portugal, and Spain, and particularly, the evolution of their REER gap with the other euro area members. This case motivates our analysis as the common pattern of real appreciation observed in the MQ countries has created concern in policy and academic circles (Bini-Smaghi 2007, EC 2006, Roubini 2007, Papademos 2007, The Economist 2007). Particular attention has been given to the fact that this pattern diverges from the average real depreciation observed in the rest of the euro area (see Figure 1). It is argued that this real appreciation is associated with a loss of international competitiveness in the MQ and that it could lead to a persistent period of slow growth, which has already materialized in the cases of Portugal and Italy (Blanchard 2006a and 2006b).[1]

In short, the REER is an aggregated measure of cost competitiveness between countries. It tracks the evolution of cost competitiveness of a particular country with respect to a weighted average of all other countries in the world.[2] The methodologies available to calculate the REER have been constantly improving in recent decades as they have been incorporating more realistic assumptions. Table 1 summarizes the existing literature and highlights the approach taken in each study to address the key elements of the REER analysis, that is, the approach used to calculate the importance or weight of each other country and the price used to measure cost competitiveness. Bayoumi *et al.* (2006 and 2005) is the most comprehensive methodology currently available, which includes the latest development in the literature.

Determining the weights by identifying the degree to which countries compete in international markets, as opposed to weighting by trade partnership, is one of the most important characteristics that distinguishes the most up-to-date REER estimations. To illustrate the importance of this feature, consider the extreme case of two countries, A and B, that export mostly to a third country C and have nil bilateral trade between them. If the weight of country B in the calculation of country A's REER is based on trade partnership, then changes in the exchange rate of country B will not alter the REER of country A. This is not a desirable feature of an index of relative cost competitiveness, since countries A and B compete when exporting to country C and

[1] For example, *The Economist* stated in early 2007 that "In particular, the Mediterranean quartet of Italy, Spain, Portugal and Greece has suffered a huge loss of competitiveness in a relatively short time...This loss is reflected in colossal current-account deficits (...) or pitifully slow growth (...)." (The Economist 2007)

[2] See Agenor (1995), Catao (2007), Chinn (2006), Fung and Klau (2006), Marsh and Tokarick (1996), Neary (2006), and Rogoff (1996) for further references to the concept of REER.

exchange rate movements in either country clearly affect the relative cost competitiveness of the other one. The interrelationship between the cost competitiveness of countries A and of country B is better captured by the REER if the weights are based on a measure of how much these two countries compete in international markets.

With respect to the method used to identify international competitors and their weights, the existing literature considers that two countries are international competitors if they both sell products in the same country, that is, in a market defined as a single aggregated sector comprising a representative product category—which we refer to as the "representative-product approach", henceforth RPA. As a result, the RPA assumes implicitly that all exporters compete with each other in the destination country. In contrast, we take a more micro-based approach that considers product heterogeneity when defining markets and identifying international competitors and their weights. For each product type that we consider, we identify international competitors as competitors competing in the market for that product type in the destination country. This allows us to analyze relative cost competitiveness at disaggregated markets according to the type of product and destination country. We aggregate these market-level REER indices to obtain a country-level REER—which we refer to as the "heterogeneous-product approach", henceforth HPA. In principle, our methodology can be applied to alternative definitions of market. Based on data availability, however, we define markets at 4-digit ISIC category of goods and at 2-digit ISIC category of services. [3]

The HPA identifies more precisely a country's direct international competitors, and thus, their weights. This feature operates at two levels: first, with respect to other exporters, and second, with respect to local producers at the destination of exports. To illustrate the differences, assume that country A exports textiles to country C, while country B exports cars to country C. The RPA focuses on competitors at an aggregate level—at the manufacturing sector for example, the most common case in the literature—suggesting that countries A and B compete in market C, even though exporters of cars are not necessarily competitors of textile exporters. Furthermore, the RPA would imply that all manufacturing goods produced in country C are competitors of exporters to country C, regardless of the type of good that is produced in, and exported to, country C. In contrast, the disaggregated view of the HPA would not consider countries A and B as competitors in this example and would consider only textile producers in country C as competitors of country A.

[3] We initially attempted to base our definition of international competitors on the degree of substitution between goods. We intended to include producers of other 4-digit level industries as competitors, weighting their importance by the degree of substitution between the corresponding goods, as measured by the cross elasticity of substitution. Available volume indices, however, present important measurement error. This affects the estimation of price indices, necessary for the estimation of the cross elasticities, and therefore, the whole methodology would have resulted in a significant increase in the variance of the REER estimates. Also, the presence of monopolistic competition at different intensities across industries and countries suggests that the estimation of cross elasticities is subject to potential identification problems. We have, therefore, assumed the simplifying assumption that the structure of international competitors within 4-digit sectors provide a good representation of the structure of competitors that exporters within those sectors face. The same is assumed for services within the 2-digit industry-level.

With respect to services exports, our approach provides a comprehensive view of relative cost competitiveness by incorporating information about exports of services as well as exports of goods. Services exports have become increasingly important and represent 65 percent of total exports in Greece, 19 percent in Italy, 27 percent in Portugal, and 31 percent in Spain. As with the case of goods, we identify competitors in the destination market at disaggregated categories of services. Unfortunately, the available data on disaggregated bilateral trade in services are not as complete as the data for trade in goods, and therefore, our estimates of the REER in services are restricted to the available sample of trade flows. The average coverage of bilateral trade ranges from 89 percent of total services exports for Greece to 59 percent for Spain. The coverage for goods is above 90 percent for all MQ countries.

Our results suggest a modest reduction in the observed REER gap between the MQ countries and the other members of the euro area. Allowing for product heterogeneity (HPA) and services exports implies, compared with the standard results obtained under the RPA, a lower real appreciation from 1998 to 2006 on the order of 2-3 percent for all MQ countries—2.0 percent for Greece, 2.8 percent for Italy, 2.4 percent for Portugal, and 2.3 percent for Spain. These figures are based on difference-in-difference estimates that control for the results obtained for the rest of the euro area countries using the same methodology. As a robustness check, we also show that our results obtained under the RPA are consistent with the ones reported using the methodology presented in Bayoumi *et al.* (2006 and 2005), the closest methodology to the one presented in this paper that uses RPA.

The above results are based on a single cost measure at the country-level as used in the current literature, namely the unit labor cost (ULC). To the extent that wages and productivity growth vary across exporting sectors, differentiated cost measures at the sector-level would yield a more accurate picture of international competitiveness. We explore this avenue and compute the REER using differentiated ULC measures at the 2-digit level. Unfortunately, the sample of countries with differentiated ULC series (28) is more restricted than the sample with aggregated ULC series (38), particularly regarding Asian countries. Also, the available time span is one year shorter than in the aggregate ULC data. Moreover, the ULC series at the industry-level may be more volatile because of its disaggregated nature, which could be magnifying some of the known problems of the ULC indicator as a measure of cost competitiveness (see footnote 2). Therefore, the results based on differentiated ULC should be taken with caution, given the data limitations detailed above, and should be read as an exploratory effort to determine the effect of differentiated cost measures on the REER.

The micro-based methodology proposed in this study also allows for a quantitative assessment of each country's profile of competitors. Such evidence provides information about the exposure of each country to its key competitors around the world; for example, the exposure to emerging competitors like China, which has shown a strong pattern of productivity and trade growth, or the exposure to countries facing significant changes in their cost structure, such as the wage moderation observed recently in Germany and the depreciation of the nominal exchange rate observed in the USA during the recent years. Our findings indicate that the bulk of competition for the MQ still comes from the advanced economies, especially from the euro

area—Spain and Portugal are more exposed to euro area competition, and therefore, less exposed to changes in the value of the euro. Nonetheless, there has been a change in the goods sector, as emerging economies have grown in importance since the late 1990s, particularly China in both high- and low-technology sectors.

The remainder of the paper is organized as follows. Section II presents the methodology used to compute the REER under the HPA. Section III describes the data used in the estimations. Section IV presents the main estimates of the REER, which account for product heterogeneity and services trade, and reports robustness checks. Section V presents the main results regarding the profile of competitors. Section VI concludes.

II. Methodology

This section presents the methodology used to estimate the evolution of the REER under the HPA. The first subsection develops a generic framework to aggregate at the country-level the relative cost competitiveness dynamics observed at the country-industry-level. This framework allows us to incorporate into the analysis elements such as global goods—goods whose markets are defined at the world-level rather than at the country-level—and local consumption of local production—the competition that local producers represent at exports' destination.

A. A Generic Approach to Aggregate Relative Cost Competitiveness

We construct our index of relative cost competitiveness between country i and the rest of the countries in the world (ROW), denoted by $R_{i,t}$, using a geometrical Laspeyres index and the chain link methodology. The subscripts g, d, and t refer to the type of product (including both goods and services), destination (country), and time (year), respectively.

The evolution of the $R_{i,t}$ index is defined in equation 1, where T denotes the base year, and $\Delta\Omega_{i,t}$ denotes the natural logarithmic change of the relative cost competitiveness between country i and the ROW between period t and $t-1$.[4]

$$\ln R_{i,t} = \ln R_{i,T} + \sum_{j=T+1}^{t} \Delta\Omega_{i,j} \tag{1}$$

The change in relative cost competitiveness at the country-level, $\Delta\Omega_{i,t}$, is constructed as the weighted average

[4]Throughout the paper, the notation Δ denotes the natural logarithmic difference between t and $t-1$ of the corresponding variable.

of the change in the relative cost competitiveness between country i and the ROW in each market defined by the g,d pair (equation 2). The change in the relative cost competitiveness in market g,d is denoted by $\Delta\theta_{i,g,d,t}$. The weights are given by the importance of each market g,d in country i's exports and are denoted by $\beta_{i,g,d,t-1}$. The term $\beta_{i,g,d,t-1}$ is computed as the share of country i's total exports represented by its exports of product g to destination d (equation 3).

$$\Delta\Omega_{i,t} = \sum_{\forall(g,d)} \beta_{i,g,d,t-1} \cdot \Delta\theta_{i,g,d,t} \tag{2}$$

$$\beta_{i,g,d,t-1} = \frac{S_{i,g,d,t-1}}{\sum_{\forall(g,d)} S_{i,g,d,t-1}} \tag{3}$$

Where $S_{c,g,d,t}$ represents sales by country c of product g in destination d; i.e. sales by country c in market g,d.

The change in relative cost competitiveness at the market-level, $\Delta\theta_{i,g,d,t}$, is given by equation 4—defined à la IMF, that is, a higher number means more appreciated. It is constructed as the difference between country i's cost change and a weighted average of the same cost change observed in all other countries competing in market g,d. The variables $P_{i,g,t}$ and $P_{c,g,t}$ represent the cost variable used to estimate cost competitiveness, are specific to each industry in each country, and are expressed in the local currency. The variable $E_{i,c,t}$ represents the exchange rate between country i and country c defined as units of country i's currency per unit of country c's currency.

$$\Delta\theta_{i,g,d,t} = \Delta P_{i,g,t} - \sum_{\forall c \neq i} \alpha_{i,c,g,d,t-1} \cdot (\Delta P_{c,g,t} + \Delta E_{c,i,t}) \tag{4}$$

The weight $\alpha_{i,c,g,d,t-1}$ is given by the importance of each country (c) as a competitor of country i in market g,d. We relate this weight to the market participation (share) of country c in market g,d, denoted by $\gamma_{c,g,d,t}$.

$$\gamma_{c,g,d,t-1} = \frac{S_{c,g,d,t-1}}{\sum_{\forall c} S_{c,g,d,t-1}} \tag{5}$$

Defining $\alpha_{i,c,g,d,t-1} = \gamma_{c,g,d,t-1}$, however, implies that the sum of the weights of all competitors is less than one, i.e. $\sum_{\forall(c\neq i,g,d)} \beta_{i,g,d,t-1} \cdot \alpha_{i,c,g,d,t-1} < 1$, because country i is not considered as a competitor of itself in equation 4. Alternatively, one could add country i in the latter sum to make it equal to one. However, doing so would violate an important property that an estimator of the REER should have: ceteris paribus, if all competitors of country i depreciate their currency by 10 percent, then, country i's REER appreciates

by 10 percent—the 10 percent property, for short. This property is violated if country i is added to the summation because the total mass of all countries excluding country i is less than one. Another alternative would be to exclude country i when computing each country's market share $\gamma_{c,g,d,t-1}$. However, this solution creates a bias, overstating the importance of small competitors relative to the importance of big competitors. To illustrate this point, assume a foreign market with two equally large competitors plus an exporter from country i. Excluding country i from the computation of the market share would imply that the other two competitors would represent 50 percent of the market, regardless of their actual importance as competitors of country i in that market.

We propose an alternative methodology to measure the importance of each country in each market as a competitor of country i, that is, $\beta_{i,g,d,t-1} \cdot \alpha_{i,c,g,d,t-1}$. We rescale the importance of each competitor in each market based on the relative importance that this competitor has in that market vis-a-vis the importance of all other competitors in all other markets (equation 6). Our adjusted measure satisfies the condition that the weights of all competitors sum up to one, that is $\sum_{\forall(c\neq i,g,d)} \beta_{i,g,d,t-1} \cdot \alpha_{i,c,g,d,t-1} = 1$, satisfies the 10 percent property, and does not over or understate the relative importance of each competitor vis-a-vis all other competitors of country i.

$$\beta_{i,g,d,t-1} \cdot \alpha_{i,c,g,d,t-1} = \frac{\beta_{i,g,d,t-1} \cdot \gamma_{c,g,d,t-1}}{\sum\limits_{\forall(c\neq i,g,d)} \beta_{i,g,d,t-1} \cdot \gamma_{c,g,d,t-1}} \tag{6}$$

B. Global Goods, Local Consumption of Local Production, RPA, and Aggregated Cost Measures

The more comprehensive REER estimates available in the current literature incorporate two important elements into the analysis (see Table 1 for details): global goods and local consumption of local production. The former refers to goods that can be characterized as commodities (e.g. copper) and for which a more appropriate definition of market is at the world-level rather than at the country-level. Regarding consumption of local production, this refers to the competition that local producers represent at exports' destination, and it is proxied by the difference between local production of a good and the exports of that good from that destination to the rest of the world.

Our generic approach can be used to consider these two elements. First, we define an artificial additional destination d that will not correspond to a particular country but to the world. Therefore, all goods g that are considered global goods (see next section for details) are assumed to compete in the market $(g, d{=}world)$. Second, we incorporate local consumption of local production by defining the case $d{=}c$, which refers to competitor c competing in the market $g, d{=}c$.

We also estimate the REER under the RPA to study the marginal effect of the HPA. The methodology presented in the previous section can easily consider this case as well by redefining all goods into a single good $g = \bar{g}$. Following Bayoumi *et al.* (2006 and 2005), we treat global goods separately under the RPA.

Finally, the lack of data limits the extent to which differentiated cost measures by sector can be modeled. The generic approach can be adjusted to consider aggregated measures for the corresponding subsectors within the defined aggregation level by simply defining $\Delta P_{c,g,t} = \Delta P_{c,\hat{g},t} \quad \forall g \quad s.t. \quad g \subset \hat{g}$, where $\hat{g}$ refers to an aggregated sector.

III. Data

A. Goods and Services

Bilateral trade data for goods are compiled from the United Nations Commodity Trade Statistics Database (COMTRADE). The data include 144 different activity classes of goods (4-digit ISIC Rev.3) across 200 countries over the period 1998-2005. Bilateral trade data for services are compiled from the OECD Statistics of International Trade in Services. The data include 9 categories of services, according to the Extended Balance of Payments Services Classification (EBOPS), across 100 countries over the period 1999-2004. The structure of competitors in 1998 and 2005 is extrapolated from the information available for 1999 and 2004, respectively. The average coverage of bilateral trade data for the MQ ranges from 86 percent of total exports of services for Greece to 59 percent for Spain. The same figures for goods are all above 90 percent.

Disaggregated local production series are needed to estimate local consumption of local production. Obtaining consistent and complete production data at 4-digit level is a challenging endeavor because available databases present significant differences in product and time coverage across countries. We approach this difficulty by combining various databases and generating (rough) estimates where possible. Our main source is the United Nations Industrial Demand-Supply Balance database (IDSB), which contains data at the 4-digit level of ISIC Rev.3 classification, which comprises 127 manufacturing commodities and 78 countries. We extend the IDSB database using (i) the annual growth rates of output reported in Eurostat's Annual Enterprise Statistics database (4-digit NACE Rev.1.1 production data);[5] (ii) the observed ratio between sectoral output and aggregate manufacturing output in Eurostat's Annual Enterprise Statistics database; (iii) the observed growth rate of output production in total manufacturing to extend the series for a maximum window of three years—if output production growth in total manufacturing is not available, we use value added growth in to-

[5]Eurostat's Annual Enterprise Statistics database has good coverage of production data, but includes only members of European Union. With respect to the correspondence used, we consider data that (i) corresponds to only one type of product at the 4-digit ISIC Rev.3 level and (ii) does not share the image with data points that correspond to more than one type of product at the 4-digit ISIC Rev.3 level.

tal manufacturing. Finally, we consider only series with complete data for the period 1998 to 2005 (original or estimated) to avoid biases/changes in the REER measures due to truncation of series unrelated to changes in relative cost competitiveness.

With respect to production of services, we use the EU KLEMS Growth and Productivity Accounts database. EU KLEMS database reports data for EU25 countries, Australia, Japan, and the USA until 2005. Production data for royalties and license fees are not considered because the match between EBOPS and ISIC Rev.3 classifications has many shared codes that makes it impossible to build a consistent correspondence. Time coverage differs across country and sectors, although to a much lower extent than in the case for goods. We extend the series in the same fashion as we do for goods, using production data from the OECD-STAN database and GDP growth rates. We consider only series with complete time series data (original or estimated).

The coverage for local production of goods, defined as the share of exports represented by the destination markets for which we can construct data on local consumption of local production, ranges from 50 percent for Greece to 70 percent for Portugal (60 percent for Italy and 66 percent for Spain). The coverage for local production of services, defined similarly, is 85 percent for Greece, 70 percent for Italy, 83 percent for Portugal, and 94 percent for Spain. These last figures are not necessarily comparable with the figures for local production of goods because their computation is based on the available bilateral trade data, which has a lower coverage for services than for goods.

We focus on REER measures that proxy cost competitiveness using the ULC, as opposed to consumer and producer price indices (CPI and PPI, respectively). The latter variables have the advantage of being available for most countries around the world. However, the ULC measure seems to be more appropriate because it considers changes in productivity. The ULC measure allows us to incorporate, albeit not perfectly, important dynamics when considering cost competitiveness, such as the Balassa-Samuelson effect and the effect of innovation and structural reforms across countries.[6]

Manufacturing ULC is used as the aggregate ULC measure at the country-level. The data are obtained directly from the OECD Analytic Database and WEO database and are available for 38 countries. Industry-level ULC data at 2-digit level is computed using the EU KLEMS database, which covers 28 countries until 2005. Table A1 in Appendix details the different samples. The industry-level ULC is computed as the ratio of the compensation of employees per hour worked to real gross value added per hour worked. The compensation of employees per hour worked is obtained from the ratio of compensation of employees to total hours worked by employees.

[6]See Lipschitz and McDonald (1992), Marsh and Tokarick (1996), Agenor (1995), Turner and Van t'dack (1993), and Cerra, Soikkeli, and Saxena (2003) for more on the advantages and disadvantages of using ULC as a measure of cost competitiveness.

Most of the disaggregated ULC series are complete for the countries covered by the EU KLEMS database, although data for 2006 are not available. Disaggregated ULC series with incomplete data for the period 1998 to 2005 are not considered and are replaced by the country's ULC series for the manufacturing sector computed from the EU KLEMS database—in order to avoid biases/changes in the REER measures due to truncation of series unrelated to changes in relative cost competitiveness.

The annual average nominal exchange rates are obtained from the IFS database.

B. Global Goods

We refer to globally traded goods as those goods whose prices are quoted on organized world exchanges as defined by Rauch (1999). Rauch (1999) classifies goods into three categories at the 4-digit SITC Rev.2. classification: commodities, reference-priced goods and differentiated goods. This classification is based on whether a good is traded and priced on organized world exchanges, listed in trade publications but not traded on organized exchanges, or does not posses a reference price, respectively.

In order to identify global goods within the 4-digit ISIC Rev.3 classification, we identify all the ISIC Rev.3 codes associated with each SITC Rev.2 in Rauch (1999) by using the UN correspondence tables. We assign a value of 1 to each good priced in organized world exchanges and a value of 3 to each good that does not possess a reference price. We calculate the average value of the associated codes for each ISIC Rev.3 code in a similar way to Jensen (2006). We define a good as globally traded at the 4-digit ISIC Rev.3 level if the value of the calculated average within each ISIC Rev.3 code lies in the interval of [1,2). Goods with values in the interval of [2,3] are not considered as globally traded goods.

Rauch (1999) presents two classifications: the "conservative" and the "liberal". The liberal version maximizes the number of globally traded goods in the cases where there was room for discretion in the sorting. Table A2 in Appendix presents the resulting group of goods identified as global goods at the 4-digit ISIC Rev.3 classification under both alternatives, conservative and liberal.

For further comparisons, we also report the goods that appear as global when applying a methodology similar to the one applied to Rauch's list to the list of global (commodity) goods defined by Bayoumi *et al.* (2006 and 2005) at the 2-digit SITC Rev.3 level. The resulting number of global goods from the latter source is higher than the one resulting from our methodology, most likely because in Bayoumi *et al.* (2006 and 2005) the list is defined at a more aggregated category of goods than in Rauch (1999) and this paper. In our analysis, we use Rauch's (1999) liberal classification following Jensen (2006), which results in a list that is closer to the one implied by the methodology used in Bayoumi *et al.* (2006 and 2005).

IV. Results

This section presents the sensitivity analysis of the REER to the HPA and to the inclusion of services exports. Based on the methodology described in Section II, we estimate the path of the REER indices under the alternative approaches and present comparative statistics.

We first compare the estimated path of the REER under the HPA, denoted by R^G, with the equivalent REER index under the RPA, denoted by R^{1G}. The difference represents the effect of relaxing the assumption that all nonglobal goods are treated as identical goods and as a result compete in the same market $\bar{g},d$, allowing differentiated goods. Second, we compare R^G with the estimates obtained for the evolution of the REER that considers only exports of services (under the HPA), denoted by R^S. This allows us to have a perspective of how the REER for goods compares with the REER for services. Third, we compute the aggregated REER index for goods and services, denoted by R^{GS}, and we compare it with R^{1G}. This difference represents the sensitivity of the REER under the RPA to both the HPA and a broader coverage of exports that includes services. In addition, we perform different robustness checks.

We also study the sensitivity of the REER for goods to heterogeneous cost dynamics across sectors. We compare the estimated REER for goods under the HPA and the heterogeneous cost dynamics assumption, denoted by R^{Gd}, where d stands for differentiated cost measures, with R^G. As detailed in the introduction, these results should be taken with caution because of data limitations and should be read as an exploratory effort to determine the effect of differentiated sectoral cost measures on the REER.

The contrast between different approaches, for example, the comparison between R^G and R^{1G}, is performed in two dimensions. First, we present the difference observed in the appreciation rates from 1998 to the corresponding year shown in the tables for both indices. Using 1998 as the base year for comparison is an adhoc rule, which has no other merit than being year prior to the adoption of the euro adoption by all the euro area countries (January 1, 1999), except for Greece (January 1, 2001). This difference in levels is computed following equation 7.

$$\text{Difference in levels (Level)} = \Delta_t\%R_i^G - \Delta_t\%R_i^{1G} \tag{7}$$

Where $\Delta_t\%$ refers to the growth rate of the index observed from 1998 to year t and i refers to the country whose REER is analyzed.

Second, we study the difference observed between the two estimations of the REER considered, for example between R^G and R^{1G}, but consider each estimator relative to the corresponding REER observed in the remaining 11 countries of the euro area. This difference-in-difference estimator is computed following equation 8.

$$\text{Difference in difference (DD)} = \left[\Delta_t \% R_i^G - \Delta_t \% R_{\text{EA}}^G\right] - \left[\Delta_t \% R_i^{1G} - \Delta_t \% R_{\text{EA}}^{1G}\right] \quad (8)$$

Where $\Delta_t\%$ refers to the growth rate of the index observed from 1998 to year t, i refers to the country whose REER is analyzed, and EA refers to the remaining 11 countries of the euro area.[7]

The difference-in-difference estimator (DD for short) is our preferred estimator for two reasons. First, it allows us to control for methodological issues specific to each type of estimation that could be driving the results without necessarily reflecting changes in relative cost competitiveness. Second, it allows us to control for the equivalent results observed in the rest of 11 euro area countries. Therefore, the DD estimator represents the change in the relative international competitiveness position between the euro area countries. This does not mean that the DD estimator considers only direct competitors from the euro area, but that it compares among euro area countries each country's position with respect to direct competitors across the world.

The euro area countries are all part of the same currency union, and therefore, are a natural benchmark to compare the evolution of the REER in each of the MQ countries and control for potential methodological differences particular to each type of estimation. This approach has also an important economic meaning. The exchange rates between euro area countries are fixed—although the euro is still sensitive to the international competitiveness of the euro area as a whole, in line with the standard exchange rate mechanisms associated with floating currencies. No rebalancing through nominal exchange rate movements is then possible, but only through productivity and wage growth differentials, which tend to take longer to materialize. As a result, divergence in international competitiveness between euro area countries is an important element when assessing the medium-term economic perspective of individual euro area countries.

A. The Effect of the Heterogeneous-Product Approach and Services

A.1 REER for goods under the HPA

Table 2 presents the estimation of the REER indices R^G and R^{1G} for the MQ countries, alongside the estimations for the two main euro area countries, France and Germany, for further comparison. The contrast between R^G and R^{1G} is reported in Table 3. The figures for the DD estimator imply that under the HPA Portugal's, Italy's, and Spain's REERs are less appreciated in the range of 2 percent in 2006 (1998 base). The difference is larger in the case of Greece, on the order of 7 percent. This indicates that, relative to the

[7] The index R_{EA}^G is computed as a geometrical index of the individual R^G indices for each of the remaining 11 countries. We construct the weights based on their relative size of exports of the particular type of product considered (goods, services, or goods and services).

effect on the other 11 euro area countries, the REER under the RPA in Greece is 7 percent more appreciated than what the model assuming the HPA suggests (since 1998).

Robustness checks

We study the robustness of our methodology and results by performing three additional contrasts. First, we compare our computation of R^{1G} with the closest measure available in the literature (based on Bayoumi *et al.* 2006 and 2005); second, we modify the sample of countries considered; and third, we study how our measure of REER changes when domestic market competition is considered.

Table 4 presents the comparison between the R^{1G} and R^{IMF}, where IMF stands for the WEO estimates of the REER based on the methodology proposed by Bayoumi *et al.* (2006 and 2005)—the closest source to our methodology that includes the latest developments in the literature and uses the RPA. The results for the DD estimator are all within the ± 1 percent range, suggesting that our methodology under the RPA yields similar results to the existing methodologies based on the RPA.[8]

Our sample of countries is based on the available information for ULC in manufacturing in OECD and the WEO databases (Table A1 in Appendix). This sample differs from the sample used to compute R^{IMF}, which considers 27 countries. An interesting aspect of the additional 11 countries used in our sample is that they constitute a sample of emerging countries not represented in the sample of 27 advanced countries, with the exception of China.[9]

We performed a second robustness check to study if our estimates of R^{G} are sensible to including the additional 11 emerging countries. We contrast R^{G} with the REER estimated under the HPA with the list of 27 countries, denoted by R^{G27}. The results, presented in Table 5, indicate that the REER estimated with the sample of 27 countries does not differ substantially from the REER estimated with the sample of 38 countries. The results for the DD estimator are all within the ± 1 percent range.

Finally, we consider the potential importance of domestic market competition for measuring international competitiveness. Due to a lack of consistent data on disaggregated internal production across MQ countries, our analysis centers on the external markets where each MQ country competes. Table 6 presents the results of contrasting R^{G} with the REER under HPA including the available information on internal markets, denoted by R^{GDM}. It indicates that the marginal effect of domestic markets is small with differences in the range of ± 1 percent.[10]

[8] Our estimates as well as the IMF estimates reported include ULC data as of August 2007.

[9] The sample of 27 countries covers on average 70-85 percent of MQ's competitors, while the sample of 38 countries covers 90-80 percent.

[10] We cannot perform this analysis for Greece because of insufficient data on its disaggregated structure of production.

Difference in the structure of competitors

We complement the results on the effect of the HPA presented in Table 3 with an aggregate view of the difference in the structure of competitors implied by the HPA and the RPA. The larger the difference, the greater the likelihood of finding a large difference between the corresponding REER measures. The actual effect, however, will depend on the interaction between the different weights and the distribution of the change in ULC across countries. In the limit, even large differences in the weights will have no effect if all countries present identical changes in their ULCs, and vice versa, even small differences in the weights can have large effects if changes in ULC are significantly different across countries.

We capture the difference in the structure of competitors implied by each approach using the formula described in equation 9. The variable $\lambda_{i,t}$ aggregates the difference observed in the weight assigned to each competitor of country i in period t.

$$\lambda_{i,t} = \sum_{\forall c \neq i} \left| \chi_{i,c,t} - \chi^{1g}_{i,c,t} \right| \tag{9}$$

Where $\chi_{i,c,t}$ is defined by equation 10 and $\beta_{i,g,d,t} \cdot \alpha_{c,g,d,t}$ refers to the relative importance of each competitor c in market (g,d) with respect to all other competitors in all other markets.[11] The variable $\chi^{1g}_{i,c,t}$ refers to the calculation under the RPA.

$$\chi_{i,c,t} = \sum_{\forall (g,d)} \beta_{i,g,d,t} \cdot \alpha_{c,g,d,t} \quad , \quad \text{where} \sum_{\forall c \neq i} \chi_{i,c,t} = 1 \tag{10}$$

Table 7 presents the results for $\lambda_{i,t}$. Greece, whose sensitivity to the HPA is the highest among all countries, presents the highest level of difference. This was expected, although as mentioned above, the fact that a difference is observed in $\lambda_{i,t}$ does not necessarily imply a difference in the REER measure; it only makes it more likely. In fact, among the rest of the countries, Portugal stands out with the largest value for $\lambda_{i,t}$, but does not present the highest sensitivity to the HPA.

Table 7 also presents the difference in the structure of competitors when comparing the HPA and the partners-approach, denoted by λp. The partners-approach refers to considering a country's trade partners as its competitors and it is used by some sources; see Chinn (2006) for more details. The results show that considering the partners-approach yields a stronger difference, two to three times the size of $\lambda_{i,t}$, when comparing it to the HPA. This difference is expected since considering competitors only on the base of trade partnerships deviates substantially from the concept of competitors used in this paper.

[11] See section 2 for more details

A.2 REER for goods and services under the HPA

Table 8 presents the estimation of the REER index R^S, which includes only services exports. To illustrate the evolution of the services component, we compare R^S and R^G in Table 9. These results suggest that except for the case of Greece, the services component of the REER has appreciated less than the goods component for the MQ countries. This difference ranges from -3.4 percent for Italy to -0.9 percent for Spain (DD estimator). For Greece, the difference goes in the opposite direction in the range of 7 percent (DD estimator).

Finally, Table 10 presents the estimation of the REER index R^{GS}, which includes both goods and services. We compare R^{GS} with R^{1G} in Table 11, which represents the aggregate sensitivity of the REER under the RPA to both the HPA and a broader coverage of exports that includes services.

The results suggest that these two additional factors together—HPa and services—have had a marginal effect on the REER on the order of -2 percent to -3 percent for all the MQ countries: -2 percent for Greece, -2.3 percent for Spain, -2.4 percent for Portugal and -2.8 percent for Italy. These numbers are consistent with the previous tables, where the smaller appreciation observed in goods for Italy, Portugal and Spain under the HPA adds to the smaller appreciation observed in services relative to goods. For the case of Greece, the strongest difference observed under the HPA shrinks significantly when combined with the larger appreciation observed in services relative to goods.

B. Differentiated ULC by Sector

Product heterogeneity (HPA) and services exports refine the REER as a measure of international competitiveness, but, as detailed in the previous section, these two factors do not change substantially the broad picture of international competitiveness in the MQ. In this section, we explore the sensitivity of the REER to the HPA with differentiated cost measures at the sector-level. Differentiated cost measures would yield a more accurate picture of international competitiveness to the extent that productivity and production costs vary across sectors. The set of results presented in this section, which indicate a higher sensitivity of the REER relative to the assumption of homogenous cost dynamics, should, however, be taken with caution. Given the data limitations detailed above, these results should be read as an exploratory effort to determine the effect of differentiated sectoral cost measures on the REER.

The results for the contrast between the REER estimated with an aggregated ULC measure (R^G) and the REER estimated with a differentiated ULC by sector (R^{Gd}) point to a higher sensitivity of the REER to the assumption of homogenous cost dynamics across sectors—both measures based on the sample for goods because of the excessive volatility found in the data for service. As shown in Table 12, the absolute differences range between 2 percent and 6 percent. For this contrast, R^G is computed using the limited data set available for the calculation of R^{Gd}.

These results are not sensitive to outliers. We recalculated the REER eliminating the 0.5 percent tails of the distribution of the annual ULC growth rates observed since 1998. No substantial differences from the results obtained in Table 12 were found. As an additional robustness check, we compared the results obtained for the contrast between R^G and R^{1G} (Table 3) with an equivalent contrast using the limited data set available for the calculation of R^{Gd}. The differences between both cases are all within the ± 1 percent range.

V. The Profile of International Competitors

The HPA proposed in our study also allows a quantitative assessment of each country's profile of competitors. Such evidence provides information about the exposure of each country to its key competitors around the world—for example, the exposure to emerging competitors like China, a country that has shown a strong pattern of productivity and trade growth, or the exposure to countries facing significant changes in their cost structure, such as the wage moderation observed recently in Germany or the depreciation of the nominal exchange rate observed in the USA during recent years. Our definition of markets also captures the potential vulnerability of each country's sectors to changing market conditions in competitors' sectors beyond the country-level.

A. Goods

For all six countries, the bulk of competition comes from the advanced and emerging economies, representing on average 95 percent in goods (except for Greece, 92 percent) and 98 percent in services. Since the late 1990s, there has been a change in the composition with emerging economies taking greater importance: they represented in 2005 14 percent of overall exposure to competition in goods for Spain, 19 percent for Italy and Portugal, and 22 percent for Greece (Table 13). China appears as the largest competitor in goods for all countries, representing at least half of the increase in the importance of emerging economies.

Among the advanced economies, the euro area countries represent 59 percent of the competition in goods faced by Spain and Portugal, 49 percent for Italy, and 47 percent for Greece. These data indicate that Spain and Portugal are more exposed to euro area competition and therefore less exposed to changes in the value of the euro. There has been a declining trend since 1998 in the range of 1 percentage point for all countries, which is smaller than the change observed for the aggregate of advanced economies.

From a sectoral point of view, the four MQ countries compete more in low-technology sectors with China—the main emerging market competitor (see Table 14). However, the importance of China in high-technology sectors is growing as well (see Figure 2). As a comparison, France and Germany compete more strongly with China in high-technology sectors, suggesting that China should not be seen as an important current and

future competitor in low-tech sectors only. [12]

Table 2 and Figure 2 also show the importance of Germany—the main advanced-country competitor—as a competitor of the MQ. The almost flat or sometimes decreasing importance of Germany highlights the strong growth of China's importance in both high- and low-technology sectors. Nonetheless, at least until 2005, Germany was still a bigger competitor for the MQ than China in both types of sectors.

B. Services

In services, emerging markets represent on average about one-third of their importance in goods, showing a similar increase in recent years although to a lesser extent (see Table 15). From 1999 to 2004, the composition shifted to emerging economies in the range of 3 percent for Greece and Italy, 2 percent for Portugal, and 1 percent for Spain. The data suggest that China does not appear as a strong competitor in services.

Among the advanced economies, the euro area countries represent 60 percent of the competition in services faced by Portugal, 50 percent for Italy, 48 percent for Spain, and 37 percent for Greece. There has been a nil trend since 1998 for all countries except for Spain, whose euro area competition has declined by 5 percentage points. These figures for services should be read with caution, given the incomplete availability of the data for bilateral trade of services.

Table 16 (goods) and Table 17 (services) present a list of the top 10 competitors for each country with their corresponding weights.

VI. Conclusion

We develop a complete methodology to reexamine the evolution of international competitiveness in the MQ, as measured by the REER. In addition to the elements considered in the existing literature, we (i) use a micro-based approach that considers product heterogeneity when identifying a each country's international competitors and their weights and (ii) include a comprehensive analysis of the services sector. Our approach enriches the REER analysis by identifying more accurately each country's direct international competitors and providing an aggregate view of international competitiveness that encompasses the complete export sector.

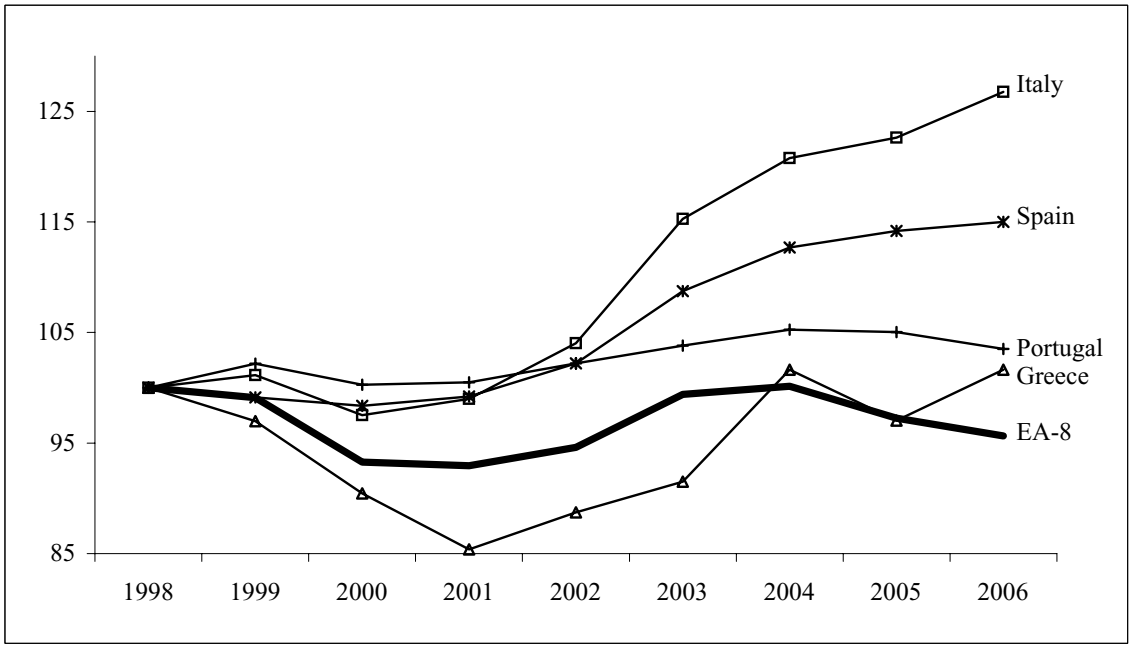
Our main findings suggest that the effect of considering both the more micro-based structure of competitors

[12] Following the OECD revised classification of sectors based upon the technology used as proposed by Hatzichronoglou (1997) we classify the 2-digit ISIC Rev.3 sectors as low- (L) and high- (H) technology sectors.

and exports of services implies a modest lower real appreciation from 1998 to 2006 on the order of 2-3 percent for all MQ countries—2.0 percent for Greece, 2.8 percent for Italy, 2.4 percent for Portugal, and 2.3 percent for Spain. These estimates are based on a difference-in-difference estimator that controls for the equivalent effect observed in the rest of 11 euro area countries.

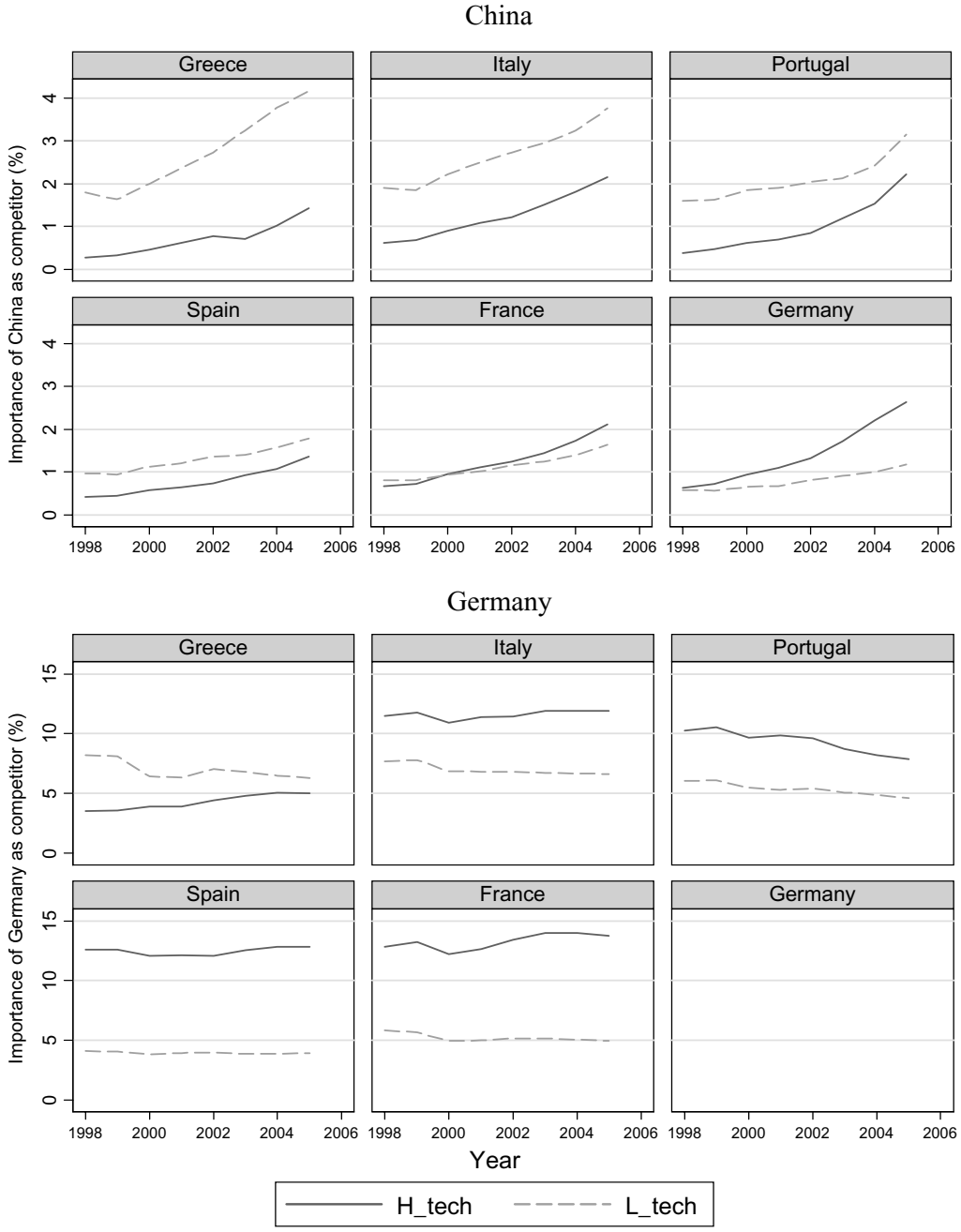
Finally, the methodology proposed in this paper also allows a detailed view of the structure of each country's competitors. Our findings indicate that the bulk of competition for the MQ still comes from the advanced economies, especially from the euro area. Nonetheless, there has been a change in the composition with emerging economies taking more importance since the late 1990s, particularly China in both the high- and low-technology sectors.

Figure 1. Real Appreciation in the MQ vs. the Rest of the Euro Area, 1998-2006



Notes: ULC-based REER index defined à la IMF (higher means more appreciated); the base year is 1998. EA-8 refers to Austria, Belgium, France, Finland, Germany, Ireland, Luxembourg, and Netherlands. The REER for the EA-8 is estimated aggregating each countries' REER and weighting by their total exports of goods. All countries adopted the euro on January 1, 1999, except for Greece, which adopted the euro on January 1, 2001. Source: OECD.

Figure 2. Importance of China and Germany as Competitors of the MQ in High-Tech and Low-Tech Sectors in Goods, 1998-2005



Notes: Technology intensity of sectors is defined according to OECD (2007) classification of industries with respect to intensity of technology used. High-tech industries comprise industries with high and medium-high intensity of technology used and low-tech industries comprise industries with low and medium-low intensity of technology used. Percentage points refer to the share of competition coming from each country.

Table 1. Literature Overview

Reference	Importance of Other Countries (Definition of Markets)				Price Competitiveness Measure
	Partners / competitors	Product & market definition (goods)	Services	Local consumption of local production	
BIS (Fung & Klau, 2006)	Competitors	**Representative-product approach.** All manufacturing goods (SITC Rev. 3 5-8) are treated as one identical good; nonmanufacturing goods are not considered. Markets are defined at the country level.	**Services are not included in the analysis.**	Total manufacturing output.	**Aggregate prices.** CPI and/or manufacturing ULC are used to measure relative cost competitiveness.
Bank of Japan (BoJ, 2007)	Partners	Total exports of goods.	**Services are not included in the analysis.**	Does not apply.	**Aggregate prices.** CPI and/or manufacturing ULC are used to measure relative cost competitiveness.
ECB (Buldorini et al., 2002)	Competitors	**Representative-product approach.** All manufacturing goods (SITC Rev. 3 5-8) are treated as one identical good; non-manufacturing goods are not considered. Markets are defined at the country level.	**Services are not included in the analysis.**	Manufacturing output for domestic use.	**Aggregate price.** CPI, manufacturing ULC, PPI and/or wholesale prices are used to measure relative cost competitiveness.
FRB (Loretan, 2005)	Average between competitors and partners	**Representative-product approach.** All goods are treated as one identical good (except for oil, gold, and military items, which are not considered).	**Services are not included in the analysis.**	Local production is not considered in the analysis.	**Aggregate prices.** CPI and/or manufacturing ULC are used to measure relative cost competitiveness.
IMF (Bayoumi et al., 2005)	Competitors	**Representative-product approach.** All manufacturing goods (SITC Rev. 3 5-8, excl. 68) are treated as one identical good. Commodities are disaggregated into 20 categories at 2-dig. SITC Rev.3 level. Markets are defined at the country level for manufactured goods and at the global level for commodities (global goods).	**Services are considered in the analysis**, but assumed to have the same trade pattern as the observed pattern for manufacturing goods. Tourism is treated separately only for a subset of countries.	Manufacturing output for domestic use.	**Aggregate prices.** CPI and/or manufacturing ULC are used to measure relative cost competitiveness.
OECD (Durand et al., 1992, 1998)	Competitors	**Representative-product approach.** All manufacturing goods (SITC Rev. 3 5-9) are treated as one identical good. Markets are defined at the country level for individual OECD countries and at the level of country aggregates for 6 non-OECD country groups.	**Services are not included in the analysis.**	Total manufacturing output.	**Aggregate price.** CPI and/or manufacturing ULC are used to measure relative cost competitiveness.
Bennett & Zarnic (2008)	Competitors	**Heterogeneous-product approach.** All goods are treated disaggregately at 4-digit ISIC Rev. 3 level. Markets are defined at the country level for all nonglobal goods and at the global level for global goods.	**Services are treated disaggregately** at 2-digit ISIC Rev. 3 level. Markets are defined at the country level for all services.	Total output for domestic use (at industry-level).	**Aggregate and disaggregate prices.** CPI, Manufacturing ULC, and sectoral ULC data for goods (1- and 2-digit ISIC Rev. 3) are used to measure relative cost competitiveness.

Notes: The representative-product approach refers to the common approach used in the literature, which assumes that all (or most) exporting goods compete with each other in the international markets. The heterogeneous-product approach refers to the approach used in this paper, which assumes that exporting goods compete with each other within disaggregated categories of goods and of services. The following examples illustrate the difference between looking at partners, looking at competitors assuming the representative-product approach, and looking at competitors assuming the heterogeneous-product approach. First, note that two countries, A and B, could compete when exporting the same good to a third country, C, while trade between countries A and B could be either high or low. This suggests that the degree of trade between countries does not necessarily reflect the degree to which countries compete in international markets. Second, assume that country A exports textiles to country C, while country B exports cars to country C. Focusing on competitors at an aggregate level—at the manufacturing sector for example, as it is the most common case in the literature—would suggest that countries A and B compete in market C, even though exporters of cars are not necessary relevant competitors of exporters of textiles. Furthermore, the homogeneous-product approach would imply that all manufacturing goods produced in country C are competitors of exporters to country C, regardless of the type of good that is produced in and exported to country C. See Chinn (2006) and Fung & Klau (2006) for a more detailed exposition of the different methodologies available in the literature.

Table 2. ULC-Based REER Indices, Goods, 1998-2006:
Heterogeneous-Product Approach (G) and Representative-Product Approach (1G)

	Greece		Italy		Portugal		Spain		France		Germany	
	G	1G	G	1G	G	1G	G	1G	G	1G	G	1G
1998	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1999	96.74	96.53	99.61	99.70	101.86	102.14	99.71	99.83	97.45	97.31	98.09	98.41
2000	89.76	89.27	94.75	94.61	99.03	99.28	98.73	98.67	91.40	91.31	90.76	91.28
2001	85.99	85.31	96.98	96.97	99.00	99.35	99.46	99.50	90.25	90.24	89.88	90.35
2002	89.44	90.03	102.12	102.50	101.47	102.00	101.58	102.03	92.41	92.41	92.63	93.02
2003	94.33	96.12	113.13	114.16	103.22	104.08	108.06	109.22	95.94	95.71	97.02	97.04
2004	107.10	112.30	120.88	122.26	102.30	103.27	112.41	113.84	97.50	96.92	97.52	97.09
2005	104.81	110.04	124.64	125.98	102.90	104.08	114.79	116.16	96.18	95.24	92.60	91.65
2006	107.91	113.90	127.96	129.21	103.09	104.21	116.58	117.77	97.48	96.35	90.31	88.99

Note: The base year is 1998.

Table 3. Net Appreciation Differential Since 1998:
Marginal Effect of Heterogeneous-Product Approach (G vs. 1G)

	Greece		Italy		Portugal		Spain		France		Germany	
	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD
1999	0.21	0.27	-0.09	-0.04	-0.29	-0.23	-0.12	-0.07	0.13	0.23	-0.32	-0.38
2000	0.49	0.61	0.13	0.28	-0.25	-0.14	0.06	0.18	0.08	0.23	-0.52	-0.60
2001	0.68	0.89	0.01	0.25	-0.34	-0.14	-0.04	0.18	0.00	0.25	-0.47	-0.39
2002	-0.59	-0.40	-0.38	-0.21	-0.53	-0.34	-0.45	-0.27	0.00	0.23	-0.39	-0.29
2003	-1.79	-1.64	-1.03	-0.99	-0.86	-0.71	-1.16	-1.06	0.22	0.46	-0.02	0.19
2004	-5.21	-5.30	-1.38	-1.64	-0.98	-1.06	-1.43	-1.59	0.58	0.61	0.43	0.54
2005	-5.22	-5.64	-1.34	-1.93	-1.18	-1.59	-1.37	-1.86	0.95	0.68	0.95	0.86
2006	-5.98	-6.66	-1.25	-2.12	-1.12	-1.78	-1.18	-1.93	1.12	0.58	1.31	1.04

Notes: G and 1G refer to the ULC-based REER for goods estimated using the heterogeneous-product approach and the representative-product approach, respectively. "Level" denotes the difference between the growth rates of G and 1G. "DD" denotes the difference-in-difference estimate between G and 1G. Results are presented in percentages (%).

Table 4. Net Appreciation Differential Since 1998:
Robustness Check 1 (1G vs. IMF)

	Greece		Italy		Portugal		Spain		France		Germany	
	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD
1999	0.06	-0.27	0.13	-0.22	0.26	-0.07	0.04	-0.31	0.15	-0.21	0.51	0.27
2000	-0.56	-0.76	-0.40	-0.69	0.14	-0.05	-0.58	-0.83	-0.27	-0.56	0.20	0.00
2001	-0.60	-0.63	-0.67	-0.80	0.08	0.05	-0.91	-1.00	-0.33	-0.43	-0.05	-0.12
2002	0.14	-0.30	0.03	-0.47	0.57	0.13	-0.51	-1.01	0.30	-0.17	0.46	0.03
2003	0.53	0.17	0.51	0.17	0.87	0.51	-0.36	-0.77	0.36	0.00	0.53	0.25
2004	1.07	0.29	1.28	0.56	1.22	0.45	-0.01	-0.84	0.71	-0.08	1.12	0.51
2005	0.35	0.15	0.50	0.33	0.81	0.62	-0.67	-0.93	0.16	-0.05	0.45	0.38
2006	0.24	0.15	0.36	0.30	0.64	0.56	-0.82	-0.96	0.06	-0.03	0.27	0.28

Notes: 1G refers to the ULC-based REER for goods estimated using the representative-product approach and IMF refers to the ULC-based REER calculated by the IMF (based on Bayoumi et al. 2005). "Level" denotes the difference between the growth rates of 1G and IMF. "DD" denotes the difference-in-difference estimate between 1G and IMF. Results are presented in percentages (%).

Table 5. Net Appreciation Differential Since 1998:
Marginal Effect of Extended Sample (G vs. G27)

	Greece		Italy		Portugal		Spain		France		Germany	
	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD
1999	-0.61	-0.75	0.05	-0.10	-0.09	-0.23	0.05	-0.09	0.09	-0.07	0.28	0.21
2000	-1.25	-1.22	-0.19	-0.18	-0.46	-0.43	-0.19	-0.16	-0.06	-0.03	0.16	0.30
2001	-1.13	-0.85	-0.42	-0.16	-0.54	-0.27	-0.37	-0.09	-0.22	0.07	-0.16	0.17
2002	-0.99	-0.71	-0.42	-0.16	-0.42	-0.14	-0.29	-0.01	-0.21	0.08	-0.21	0.10
2003	-0.67	-0.57	-0.25	-0.17	-0.24	-0.14	-0.05	0.06	-0.09	0.02	-0.02	0.13
2004	-0.87	-0.77	-0.31	-0.24	-0.28	-0.18	-0.03	0.08	-0.10	0.01	0.01	0.17
2005	-1.58	-1.20	-0.83	-0.49	-0.64	-0.26	-0.42	-0.03	-0.35	0.05	-0.21	0.27
2006	-1.38	-1.05	-0.81	-0.54	-0.54	-0.21	-0.37	-0.04	-0.31	0.03	-0.13	0.30

Notes: G and G27 refer to the ULC-based REER for goods estimated using the heterogeneous-product approach and the heterogeneous-product approach based on a reduced sample of 27 countries, respectively. "Level" denotes the difference between the growth rates of G and G27. "DD" denotes the difference-in-difference estimate between G and G27. Results are presented in percentages (%).

Table 6. Net Appreciation Differential Since 1998:
Marginal Effect of Domestic Market Competition (G vs. GIM)

	Greece		Italy		Portugal		Spain		France		Germany	
	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD
1999	na	na	-0.26	-0.05	-0.11	0.10	-0.22	-0.01	-0.15	0.07	-0.40	-0.27
2000	na	na	-0.82	-0.07	-0.52	0.25	-0.90	-0.15	-0.99	-0.27	-1.15	-0.58
2001	na	na	-1.00	-0.31	-0.48	0.25	-1.08	-0.37	-0.95	-0.26	-0.95	-0.33
2002	na	na	-0.76	-0.38	-0.06	0.37	-0.90	-0.50	-0.48	-0.07	-0.50	-0.10
2003	na	na	-0.26	-0.40	0.83	0.76	-0.47	-0.59	0.40	0.37	0.20	0.17
2004	na	na	0.03	-0.46	1.38	0.96	-0.20	-0.68	0.98	0.66	0.69	0.39
2005	na	na	-0.18	-0.68	1.44	1.02	-0.35	-0.83	0.99	0.67	0.77	0.52
2006	na	na	-0.26	-0.79	1.57	1.14	-0.33	-0.83	1.04	0.70	0.79	0.54

Notes: G and GIM refer to the ULC-based REER for goods estimated using the heterogeneous-product approach and the heterogeneous-product approach including domestic market competition, respectively. "Level" denotes the difference between the growth rates of G and GIM. "DD" denotes the difference-in-difference estimate between G and GIM. Results are presented in percentages (%).

Table 7. The Structure of Competitors:
Heterogeneous- vs. Representative-Product Approach (λ) and vs. Partners Approach (λp)

	Greece		Italy		Portugal		Spain		France		Germany	
	λ	λp	λ	λp	λ	λp	λ	λp	λ	λp	λ	λp
1999	0.134	0.309	0.054	0.170	0.105	0.196	0.070	0.186	0.051	0.203	0.063	0.219
2000	0.135	0.325	0.060	0.174	0.105	0.213	0.073	0.194	0.052	0.203	0.065	0.211
2001	0.132	0.347	0.062	0.179	0.106	0.213	0.071	0.202	0.056	0.206	0.065	0.202
2002	0.127	0.342	0.065	0.182	0.105	0.200	0.074	0.213	0.057	0.205	0.068	0.203
2003	0.125	0.319	0.065	0.190	0.102	0.200	0.074	0.206	0.058	0.210	0.067	0.204
2004	0.131	0.318	0.063	0.197	0.096	0.193	0.072	0.220	0.058	0.208	0.068	0.201
2005	0.132	0.310	0.065	0.189	0.099	0.197	0.070	0.222	0.062	0.196	0.068	0.198
Average	0.133	0.322	0.061	0.183	0.103	0.201	0.072	0.204	0.056	0.204	0.067	0.208

Notes: Following equation 9, λ refers to the difference in the structure of competitors for goods when comparing the heterogeneous-product approach with the representative-product approach. Likewise, λp refers to the difference in the structure of competitors when comparing the heterogeneous-product approach with the partners-approach for goods.

Table 8. ULC-Based REER Indices, Services, 1998-2006:
Heterogeneous-Product Approach (S)

	Greece	Italy	Portugal	Spain	France	Germany
1998	100.00	100.00	100.00	100.00	100.00	100.00
1999	95.61	98.94	101.71	99.74	96.33	97.80
2000	84.71	93.21	97.59	97.90	88.97	90.67
2001	80.27	95.88	97.59	98.73	88.14	89.97
2002	86.70	101.03	100.26	100.97	90.27	92.20
2003	94.95	112.21	102.80	109.23	94.76	96.07
2004	113.06	118.95	101.64	112.98	96.07	96.28
2005	110.78	122.49	101.83	114.58	94.15	91.28
2006	114.55	125.62	101.39	115.35	95.19	89.02

Note: The base year is 1998.

Table 9. Net Appreciation Differential Since 1998:
Difference between Services and Goods (S vs. G)

	Greece		Italy		Portugal		Spain		France		Germany	
	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD
1999	-1.13	-0.18	-0.67	0.36	-0.14	0.91	0.03	1.26	-1.11	-0.12	-0.29	0.94
2000	-5.05	-4.07	-1.54	-0.39	-1.44	-0.16	-0.84	0.82	-2.42	-1.42	-0.09	1.82
2001	-5.72	-5.28	-1.10	-0.33	-1.41	-0.50	-0.74	0.57	-2.11	-1.48	0.09	1.79
2002	-2.73	-1.63	-1.09	0.17	-1.21	0.18	-0.62	1.23	-2.14	-0.94	-0.43	1.63
2003	0.61	1.37	-0.92	-0.24	-0.42	0.50	1.18	2.79	-1.18	-0.34	-0.94	0.66
2004	5.97	7.01	-1.93	-1.73	-0.66	-0.01	0.57	1.93	-1.43	-0.95	-1.25	0.44
2005	5.96	6.40	-2.15	-2.66	-1.07	-0.99	-0.21	0.63	-2.03	-2.36	-1.32	0.57
2006	6.64	6.77	-2.34	-3.36	-1.70	-2.05	-1.24	-0.86	-2.29	-3.15	-1.28	0.65

Notes: S refers to the ULC-based REER for services estimated using the heterogeneous-product approach and G refers to the ULC-based REER for goods estimated using the heterogeneous-product approach. "Level" denotes the difference between the growth rates of S and G. "DD" denotes the difference-in-difference estimate between S and G. Results are presented in percentages (%).

Table 10. ULC-Based REER Indices, Goods & Services, 1998-2006:
Heterogeneous-Product Approach (GS)

	Greece	Italy	Portugal	Spain	France	Germany
1998	100.00	100.00	100.00	100.00	100.00	100.00
1999	96.00	99.49	101.81	99.71	97.24	98.06
2000	86.27	94.48	98.62	98.50	90.94	90.75
2001	82.01	96.79	98.60	99.25	89.86	89.89
2002	87.67	101.93	101.12	101.40	92.02	92.58
2003	95.03	112.96	103.11	108.36	95.77	96.91
2004	111.42	120.54	102.13	112.56	97.29	97.39
2005	109.16	124.26	102.62	114.75	95.85	92.47
2006	112.71	127.55	102.64	116.30	97.10	90.18

Note: The base year is 1998.

Table 11. Net Appreciation Differential Since 1998:
Joint Marginal Effect of the Heterogeneous-Product Approach, Including Services (GS vs. 1G)

	Greece		Italy		Portugal		Spain		France		Germany	
	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD
1999	-0.53	-0.30	-0.21	0.04	-0.33	-0.08	-0.12	0.15	-0.08	0.20	-0.35	-0.15
2000	-3.00	-2.69	-0.14	0.25	-0.66	-0.30	-0.17	0.27	-0.38	-0.03	-0.53	-0.17
2001	-3.29	-3.00	-0.18	0.21	-0.75	-0.37	-0.25	0.21	-0.38	-0.01	-0.46	0.00
2002	-2.36	-2.00	-0.57	-0.18	-0.88	-0.46	-0.63	-0.15	-0.39	0.02	-0.44	0.08
2003	-1.09	-0.86	-1.20	-1.07	-0.97	-0.71	-0.85	-0.53	0.06	0.38	-0.13	0.37
2004	-0.88	-0.87	-1.72	-2.00	-1.15	-1.20	-1.28	-1.29	0.36	0.38	0.30	0.68
2005	-0.88	-1.32	-1.72	-2.50	-1.46	-1.97	-1.41	-1.86	0.62	0.15	0.82	1.03
2006	-1.19	-1.96	-1.67	-2.82	-1.57	-2.44	-1.46	-2.27	0.75	-0.11	1.19	1.21

Notes: GS refers to the ULC-based REER for goods and services estimated using the heterogeneous-product approach and 1G refers to the ULC-based REER for goods estimated using the representative-product approach. "Level" denotes the difference between the growth rates of GS and 1G. "DD" denotes the difference-in-difference estimate between GS and 1G. Results are presented in percentages (%).

Table 12. Net Appreciation Differential Since 1998:
Marginal Effect of Differentiated ULC (Gd vs. G)

	Greece		Italy		Portugal		Spain		France		Germany	
	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD	Level	DD
1999	0.15	-0.04	-1.29	-1.71	-2.21	-2.43	-0.09	-0.30	-0.82	-1.20	2.22	2.96
2000	1.61	0.95	-0.88	-1.79	-1.14	-1.83	-0.48	-1.23	-0.04	-0.85	4.00	4.86
2001	0.85	0.48	-0.82	-1.38	-1.17	-1.57	-1.48	-1.98	0.59	0.25	2.23	2.72
2002	2.57	2.05	-1.09	-1.86	-2.82	-3.40	-0.89	-1.52	0.42	-0.13	1.23	1.02
2003	1.83	1.24	-1.28	-2.12	-1.88	-2.51	-0.71	-1.38	1.44	1.02	0.44	-0.22
2004	1.32	-0.11	-1.92	-3.79	-0.95	-2.41	-2.90	-4.61	0.96	-0.57	2.38	1.41
2005	5.57	4.24	-3.98	-6.00	-0.64	-2.02	-3.67	-5.34	-0.30	-2.00	2.90	2.32
2006	na	na	na	na	na	na	na	na	na	na	na	na

Notes: Gd and G refer to the ULC-based REER for goods estimated using the heterogeneous-product approach with differentiated ULC measures and the heterogeneous-product approach with a country-level ULC measure, respectively. "Level" denotes the difference between the growth rates of Gd and G. "DD" denotes the difference-in-difference estimate between Gd and G. Results are presented in percentages (%).

Table 13. Structure of Competitors: Goods

	Greece	Italy	Portugal	Spain	France	Germany
Euro area, 1998	47.5%	49.7%	60.0%	59.9%	48.9%	42.6%
Euro area, 2005	47.0%	48.6%	58.6%	58.5%	48.6%	41.1%
Advanced economies, 1998	72.4%	81.4%	83.7%	85.9%	85.7%	84.5%
Advanced economies, 2005	69.9%	75.7%	77.0%	81.5%	80.1%	77.4%
Emerging economies, 1998 (1)	18.6%	14.7%	12.7%	11.1%	11.7%	11.8%
Emerging economies, 2005 (2)	22.0%	19.2%	19.0%	14.4%	15.9%	17.7%
Change in percentage points (2)-(1)	3.4%	4.5%	6.3%	3.3%	4.3%	5.9%
Change in percentage points due to China	3.5%	3.4%	3.4%	1.8%	2.3%	2.6%

Note: Percentage points refer to the share of competition coming from each country or group of countries.

Table 14. Structure of Competitors in High-Tech and Low-Tech Sectors in 2005

	Greece	Italy	Portugal	Spain	France	Germany
China as competitor						
High-tech sectors	1.43%	2.16%	2.22%	1.36%	2.12%	2.64%
Low-tech sectors	4.17%	3.76%	3.15%	1.79%	1.64%	1.18%
Germany as competitor						
High-tech sectors	5.01%	11.94%	7.84%	12.82%	13.74%	…
Low-tech sectors	6.29%	6.63%	4.61%	3.90%	4.95%	…

Notes: Technology intensity of sectors is defined according to OECD (2007) classification of industries with respect to intensity of technology used in sectors producing goods. High-tech industries comprise 2-digit industries with high and medium-high intensity of technology used and low-tech industries comprise 2-digit industries with low and medium-low intensity of technology used. Percentage points refer to the share of competition coming from each country.

Table 15. Structure of Competitors: Services

	Greece	Italy	Portugal	Spain	France	Germany
Euro area, 1999	37.4%	49.6%	60.3%	54.4%	42.8%	46.0%
Euro area, 2004	37.2%	50.2%	60.3%	48.1%	42.5%	40.7%
Advanced economies, 1999	95.9%	94.1%	97.1%	95.8%	95.1%	93.6%
Advanced economies, 2004	92.0%	89.7%	94.7%	93.5%	91.1%	87.8%
Emerging economies, 1999 (1)	3.5%	4.9%	2.4%	3.5%	4.2%	5.0%
Emerging economies, 2004 (2)	6.4%	7.5%	3.9%	4.7%	6.7%	8.6%
Change in % points (2)-(1)	2.9%	2.6%	1.5%	1.2%	2.5%	3.6%
Change in % points due to China	0.3%	0.2%	0.1%	0.1%	0.2%	0.3%
Change in % points due to top 5 EE	2.0%	1.6%	0.6%	0.5%	1.8%	2.3%

Note: The key 5 emerging economies (EE) competitors for Greece are South Korea, Turkey, Hungary, Czech Rep., Hong Kong; for Italy, they are Hungary, Turkey, Czech Rep., South Korea, Hong Kong; for Portugal, they are Turkey, Czech Rep., Egypt, Hungary, Mexico; for Spain, they are Turkey, Czech Rep. Egypt, Hungary, South Africa; for France, they are South Korea, Turkey, Hong Kong, Hungary, Czech Rep.; and for Germany, they are South Korea, Hong Kong, Czech Rep., Turkey and Hungary.

Table 16. Main Competitors in 2005: Goods

Rank	Greece	Italy	Portugal	Spain	France	Germany
1	Italy (11.84%)	Germany (18.63%)	Spain (15.76%)	Germany (16.92%)	Germany (18.82%)	US (13.40%)
2	Germany (11.50%)	France (11.60%)	Germany (12.52%)	France (16.46%)	US (12.20%)	France (11.68%)
3	France (7.13%)	US (9.72%)	France (12.20%)	Italy (9.98%)	Italy (9.62%)	Italy (9.37%)
4	US (6.54%)	Spain (6.26%)	Italy (8.52%)	US (7.23%)	UK (7.76%)	UK (7.70%)
5	UK (6.14%)	UK (6.25%)	US (5.81%)	UK (6.49%)	Spain (6.82%)	Japan (6.85%)
6	China (5.76%)	China (5.95%)	UK (5.63%)	Belgium (4.29%)	Japan (4.46%)	Netherlands (4.78%)
7	Spain (4.51%)	Japan (4.33%)	China (5.41%)	Netherlands (4.06%)	Belgium (4.24%)	Spain (4.71%)
8	Belgium (4.15%)	Belgium (3.71%)	Belgium (3.65%)	Portugal (3.95%)	Netherlands (4.10%)	Belgium (4.14%)
9	Netherlands (3.93%)	Netherlands (3.23%)	Netherlands (3.35%)	Japan (3.37%)	China (3.80%)	China (3.83%)
10	Turkey (3.59%)	Austria (2.23%)	Japan (2.41%)	China (3.23%)	Korea (1.96%)	Sweden (2.73%)

Notes: Percentage points refer to the share of competition coming from each country.

Table 17. Main Competitors in 2004: Services

Rank	Greece	Italy	Portugal	Spain	France	Germany
1	US (29.57%)	US (15.85%)	UK (17.73%)	UK (26.40%)	US (16.20%)	US (15.97%)
2	UK (16.20%)	Germany (14.45%)	Spain (17.49%)	Germany (13.79%)	UK (16.16%)	France (10.38%)
3	Germany (9.60%)	France (13.12%)	France (14.53%)	France (11.74%)	Italy (10.38%)	Japan (10.20%)
4	Italy (7.87%)	UK (11.47%)	US (9.24%)	US (8.75%)	Germany (9.68%)	UK (9.71%)
5	France (7.33%)	Spain (6.04%)	Germany (8.98%)	Italy (7.63%)	Japan (8.60%)	Italy (9.38%)
6	Spain (2.89%)	Japan (5.21%)	Italy (6.77%)	Portugal (3.79%)	Spain (5.88%)	Netherlands (4.89%)
7	Netherlands (2.67%)	Austria (5.06%)	Belgium (3.81%)	Austria (2.67%)	Belgium (4.78%)	Spain (4.12%)
8	Austria (2.57%)	Belgium (2.92%)	Netherlands (2.79%)	Netherlands (2.54%)	Netherlands (3.36%)	Austria (3.77%)
9	Japan (2.51%)	Netherlands (2.76%)	Austria (1.95%)	Sweden (2.52%)	Austria (2.65%)	Belgium (3.41%)
10	Belgium (2.17%)	Greece (2.66%)	Japan (1.71%)	Belgium (2.36%)	Sweden (2.23%)	Denmark (3.16%)

Notes: Percentage points refer to the share of competition coming from each country.

Appendix Table A1. Availability of Unit Labor Cost Data

	Country	Country-level ULC		Differentiated ULC
		Sample of 38 countries	Sample of 27 countries	Sample of 28 countries
1	Australia	Yes	Yes	Yes
2	Austria	Yes	Yes	Yes
3	Belgium	Yes	Yes	Yes
4	Canada	Yes	Yes	No
5	China, P.R.: Hong Kong	Yes	Yes	No
6	Colombia	Yes	No	No
7	Czech Republic	Yes	No	Yes
8	Denmark	Yes	Yes	Yes
9	Finland	Yes	Yes	Yes
10	France	Yes	Yes	Yes
11	Germany	Yes	Yes	Yes
12	Greece	Yes	Yes	Yes
13	Hungary	Yes	No	Yes
14	Iceland	Yes	No	No
15	Ireland	Yes	Yes	Yes
16	Israel	Yes	Yes	No
17	Italy	Yes	Yes	Yes
18	Japan	Yes	Yes	Yes
19	Korea	Yes	Yes	No
20	Luxembourg	Yes	Yes	Yes
21	Macedonia, FYR	Yes	No	No
22	Mexico	Yes	No	No
23	Netherlands	Yes	Yes	Yes
24	New Zealand	Yes	Yes	No
25	Norway	Yes	Yes	No
26	Poland	Yes	No	Yes
27	Portugal	Yes	Yes	Yes
28	Singapore	Yes	Yes	No
29	Slovak Republic	Yes	No	Yes
30	Slovenia	Yes	No	Yes
31	South Africa	Yes	No	No
32	Spain	Yes	Yes	Yes
33	Sweden	Yes	Yes	Yes
34	Switzerland	Yes	Yes	No
35	Taiwan	Yes	Yes	No
36	Turkey	Yes	No	No
37	United Kingdom	Yes	Yes	Yes
38	United States	Yes	Yes	Yes
39	Cyprus	No	No	Yes
40	Estonia	No	No	Yes
41	Lithuania	No	No	Yes
42	Litva	No	No	Yes
43	Malta	No	No	Yes

Notes: Country-level ULC data compiled from the OECD database and IMF World Economic Outlook database. Differentiated 2-digit sector level ULC data compiled from EU KLEMS.

Appendix Table A2. Classification of Global Goods

ISIC Rev.3 (4-digit)	Activity Description	Rauch Classification		IMF
		Conservative	Liberal	
0111	Growing of cereals and other crops n.e.c.	Global	Global	Global
0112	Growing of vegetables, horticultural specialties and nursery products	/	/	Global
0113	Growing of fruit, nuts, beverage and spice crops	Global	Global	Global
0121	Farming (cattle, sheep, goats, horses, asses, mules and hinnies; dairy)	Global	Global	Global
0122	Other animal farming; production of animal products n.e.c.	/	/	Global
0200	Forestry, logging and related service activities	/	/	Global
0500	Fishing operations	/	/	Global
1110	Extraction of crude petroleum and natural gas	/	Global	/
1200	Mining of uranium and thorium ores	/	Global	Global
1310	Mining of iron ores	Global	Global	Global
1320	Mining of non-ferrous metal ores, except uranium and thorium ores	/	Global	Global
1410	Quarrying of stone, sand and clay	/	/	Global
1421	Mining of chemical and fertilizer minerals	/	/	Global
1422	Extraction of salt	/	/	Global
1429	Other mining and quarrying n.e.c.	/	/	Global
1511	Production, processing and preserving of meat and meat products	Global	Global	Global
1512	Processing and preserving of fish and fish products	/	/	Global
1513	Processing and preserving of fruit and vegetables	/	/	Global
1514	Manufacture of vegetable and animal oils and fats	Global	Global	Global
1520	Manufacture of dairy products	/	Global	Global
1531	Manufacture of grain mill products	/	/	Global
1532	Manufacture of starches and starch products	/	/	Global
1533	Manufacture of prepared animal feeds	/	/	Global
1541	Manufacture of bakery products	/	/	Global
1542	Manufacture of sugar	Global	Global	Global
1543	Manufacture of cocoa, chocolate and sugar confectionery	/	/	Global
1544	Manufacture of farinaceous products (macaroni and similar)	/	/	Global
1549	Manufacture of other food products n.e.c.	/	/	Global
1551	Distilling, rectifying and blending of spirits	/	/	Global
1552	Manufacture of wines	/	/	Global
1553	Manufacture of malt liquors and malt	/	/	Global
1554	Manufacture of soft drinks; production of mineral waters	/	/	Global
1600	Manufacture of tobacco products	/	/	Global
2010	Sawmilling and planing of wood	/	/	Global
2411	Manufacture of basic chemicals, exc. fertilizers & nitrogen compounds	Global	Global	/
2412	Manufacture of basic precious and non-ferrous metals	/	Global	/
2720	Manufacture of basic precious and non-ferrous metals	Global	Global	Global
9302	Hairdressing and other beauty treatment	/	/	Global
Total		**9**	**14**	**35**

Notes: We refer to globally traded goods as goods whose prices are quoted on organized world exchanges as defined by Rauch (1999). These goods are characterized as commodities for which a more appropriate definition of market is at the world level. Rauch distinguishes between conservative and liberal classifications. We use the liberal classification that maximizes the number of global goods. For comparison reasons, we identify an additional list of global goods (denoted by IMF) in line with Bayoumi et al. (2005).

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