Relative Prices and Sectoral Productivity†

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August 2012

Abstract

The relative price of services rises with development. A standard interpretation of this fact is that cross-country productivity differences must be larger in manufacturing (tradables) than in services (non-tradables). Using detailed data from the International Comparison Program we disaggregate the service sector and show that the behaviour of the relative price is markedly different across two broad classifications of services: traditional services such as government, health, and education featuring a rising relative price with development and non-traditional services such as communication, transportation, insurance and financial services featuring a declining relative price. Moreover, there is a structural transformation within services whereby the share of non-traditional services rises with development. What are the productivity implications of disaggregating the service sector? Using a simple development accounting framework and a model of the structural transformation within services, we find that cross-country productivity differences are large in non-traditional services, at least as large as those in manufacturing. Development requires also an emphasis on solving the productivity problem in non-traditional services in poor countries.

JEL classification: O1, O4, E0.

Keywords: Productivity, services, traditional, non-market, structural transformation.

†Very preliminary and incomplete. Please do not quote. We thank David Lagakos and Xiaodong Zhu for comments and suggestions. All errors are our own. We gratefully acknowledge the support from the Connaught Fund at the University of Toronto (Duarte) and the Social Sciences and Humanities Research Council of Canada (Restuccia). Contact Information: Department of Economics, University of Toronto, 150 St. George Street, Toronto, ON M5S 3G7, Canada. E-mail: margarida.duarte@utoronto.ca and diego.restuccia@utoronto.ca.
1 Introduction

There are large differences in incomes across countries. For instance, measured at international prices, gross domestic product (GDP) per capita in the richest 10 percent of countries in the world is 40 times that of the poorest 10 percent of countries in 2005. Most studies agree that labor productivity (and total factor productivity) differences across countries are the primary factor explaining differences in income across countries. A large literature following Kuznets (1966) has emphasized the importance of the sectoral allocation of factors and productivity in understanding aggregate outcomes.

The cornerstone limitation of a proper quantitative assessment of the sectoral structure is the lack of comprehensive sectoral productivity data for a large number of countries. A standard approach in the literature to circumvent the data limitations is to use sectoral price and expenditure data to back out sectoral productivity. From this literature, a well-known fact is that the relative price of services rises with development and the standard interpretation of this finding is that cross-country differences in productivity are larger in manufacturing than in services, e.g.: Balassa-Samuelson, Kravis, Heston, and Summers (1983), Hsieh and Klenow (2007), Herrendorf and Valentinyi (2011). We argue that heterogeneity in the service sector is important for sectoral productivity implications.

The service sector is very heterogeneous. We disaggregate services between traditional and non-traditional. We find that the relative price of traditional services rises with income while that of non-traditional services falls with income. And, as income grows, there is a structural transformation within the service sector. Keeping the U.S. shares of traditional and non-traditional services constant across countries implies a relative price of services that does not vary with income. These facts suggest that a development strategy based solely in improving productivity primarily in the manufacturing sector may be limited in its effects.

To assess the importance of disaggregating the services sector for productivity implications,
we first use a development accounting framework which imposes very little structure by using all pieces of the data available (expenditures and prices). The analysis reveals that labor productivity differences in non-traditional services are as large as those in manufacturing and much larger than those in traditional services. Development is associated with a reallocation of real expenditures to non-traditional services. To understand more deeply what drives this process, we then develop a model of the structural transformation that includes traditional and non-traditional services. The model reinforces the finding that productivity differences are large in non-traditional services.

The paper is organized as follows. In the next section, we elaborate on a set of facts about sectoral structure and prices from the ICP data. Section 3 performs a simple development accounting as a first pass to assess the productivity implications of disaggregating services. In Section 4, we lay out a standard model of structural transformation to study the reallocation of real expenditures to non-traditional services and study the sectoral and aggregate implications, we calibrate the model and present the main results. We conclude in Section 5.

2 Facts

We use detailed price and expenditure data from the International Comparisons Program (ICP) for 2005. The data is the basis for the construction of the widely-used Penn World Table (PWT) where comparable measures of gross domestic product are available for a large number of countries and years. The ICP data reports information on 129 detailed expenditure categories (broadly divided among consumption, investment, and government) for 146 countries. We restrict our sample of countries to those with more than 1 million population, leaving 130 countries. The country coverage represents well the entire world distribution of income per capita. The data contains information on price indices of individual expendi-
ture categories and nominal expenditures (expenditures on individual categories in units of
domestic prices). From these data, nominal expenditures, real expenditures (in units of an
average international price which is common across countries), and prices can be constructed
for arbitrary aggregates such as consumption, investment, tradables, services, among others.¹

From the individual categories we construct an aggregate category of services.² While every
expenditure category may contain a service component, perhaps as an intermediate input,
aggregate expenditure in services is a close approximation to total services in the economy.
We document the behavior of the relative price of services and the expenditure share of
services (nominal and real) across countries. A summary of the data is reported in Table 1.

We emphasize the following facts:

(1) The price of services relative to that of GDP increases with income per capita. That
is, the relative price of services is higher in rich countries compared to poor countries.
We report the relative price of services against GDP per capita across countries in
Figure 1. On average, the richest 5 percent of countries have a relative price of services
which is a factor of 2 of the price in the poorest 5 percent of countries. This is a well
known fact that has been emphasized in the related literature (see e.g. Kravis, et al.,
Summers and Heston, among many others).

(2) The (nominal) share of services in GDP increases with income per capita, that is, the
share of expenditures in services is larger in rich compared to poor countries. See
Figure 2. While rich countries dedicate about 50 percent of their GDP to service
expenditures, poor countries spend only 30 percent. This fact is also relatively well
know. However, what is less known is whether the expenditure share in services rises
with income because there are more purchases of services in rich countries or because
the prices of those services are higher in rich countries. This observation leads to our

¹See the data appendix for more details.
²In the appendix we document a detailed list of individual categories included as services.
The real share of services in GDP, where real refers to being measured at international prices, does not vary systematically with income per capita. That is, rich and poor countries tend to spend the same fraction of their real expenditures in services, at an average of around 50 percent for all countries. See Figure 3.

Table 1: Relative Prices and Expenditure Shares

<table>
<thead>
<tr>
<th>Deciles</th>
<th>RGDPpc</th>
<th>$P_s/P$</th>
<th>$sQ_s$</th>
<th>$sE_s$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.02</td>
<td>0.56</td>
<td>0.48</td>
<td>0.32</td>
</tr>
<tr>
<td>2</td>
<td>0.03</td>
<td>0.62</td>
<td>0.52</td>
<td>0.38</td>
</tr>
<tr>
<td>3</td>
<td>0.05</td>
<td>0.56</td>
<td>0.45</td>
<td>0.28</td>
</tr>
<tr>
<td>4</td>
<td>0.09</td>
<td>0.60</td>
<td>0.49</td>
<td>0.33</td>
</tr>
<tr>
<td>5</td>
<td>0.13</td>
<td>0.63</td>
<td>0.50</td>
<td>0.37</td>
</tr>
<tr>
<td>6</td>
<td>0.19</td>
<td>0.67</td>
<td>0.51</td>
<td>0.41</td>
</tr>
<tr>
<td>7</td>
<td>0.27</td>
<td>0.65</td>
<td>0.51</td>
<td>0.39</td>
</tr>
<tr>
<td>8</td>
<td>0.41</td>
<td>0.75</td>
<td>0.47</td>
<td>0.41</td>
</tr>
<tr>
<td>9</td>
<td>0.66</td>
<td>0.89</td>
<td>0.48</td>
<td>0.51</td>
</tr>
<tr>
<td>10</td>
<td>0.89</td>
<td>0.96</td>
<td>0.41</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Ratio 10/1 | 49.3 | 1.70 | 0.85 | 1.45 |
Ratio 9/2 | 20.6 | 1.44 | 0.92 | 1.32 |

Note: Countries are ranked according to GDP per capita and divided among deciles. For each decile we report: (1) GDP per capita relative to that of the United States (RGDPpc), (2) the price of services relative to the price of GDP ($P_s/P$), (3) the real expenditure share of services to GDP ($sQ_s$), (4) the nominal expenditure share of services to GDP ($sE_s$).

The set of categories that comprises services is very heterogeneous. For instance, it comprises categories such as hospital services, household services, insurance, among many others. The detailed ICP price data also reflects this heterogeneity. In particular, we find that the behavior of the price of individual service categories with respect to the price of GDP can differ markedly across categories. To summarize this heterogeneity, we divide services into two broad categories. The first broad category, which we call traditional services, comprises
the government and all service categories in personal consumption expenditures for which its relative price increases with income across countries. The main components of traditional services are government, actual and imputed rents for housing, health services, and education. The second broad category, which we call non-traditional services, comprises all service categories in personal consumption expenditures for which its relative price declines with income across countries. The main components of non-traditional services are transport services, communication services, and financial and related services. Table 2 summarizes the price and expenditure implications of these two broad categories within services.

We emphasize the following facts:

(4) The relative price of traditional services increases with income while the relative price of non-traditional services declines with income. In addition, traditional services are cheap while non-traditional services are expensive (relative to the price of GDP). See Figures 4, 5, and 6.

(5) The real share of traditional services (in total services) declines with income while the real share of non-traditional services increases with income. This reallocation between the two broad service categories is substantial, with poor countries allocating most of the real service expenditure to traditional services whereas rich countries allocate 40 percent of the real service expenditure to non-traditional services. See Figure 7.

Richer countries, compared to poorer countries, tend to allocate a higher share of real expenditures to non-traditional services, which are relatively more expensive than traditional services. This reallocation in development may explain the rising relative price of aggregate

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3These four components represent at least 80 percent of real expenditures in traditional services in all countries. The cross-country average is 95 percent.
4These components represent, on average, 55 percent of real expenditures in non-traditional services.
5We use the terminology traditional and non-traditional to broadly characterize the main distinction across services categories but the same categories can be broadly characterized as market vs. non-market services, and broadly speaking our facts are robust to other characterizations of the service sector.
Table 2: Relative Prices and Expenditure Shares — Services

<table>
<thead>
<tr>
<th>Deciles</th>
<th>RGDPpc</th>
<th>$P_{St}/P$</th>
<th>$P_{Sn}/P$</th>
<th>$sQ_{SN}$</th>
<th>$sE_{SN}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.02</td>
<td>0.38</td>
<td>1.91</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>2</td>
<td>0.03</td>
<td>0.44</td>
<td>1.83</td>
<td>0.07</td>
<td>0.11</td>
</tr>
<tr>
<td>3</td>
<td>0.05</td>
<td>0.39</td>
<td>1.62</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>4</td>
<td>0.09</td>
<td>0.43</td>
<td>1.26</td>
<td>0.10</td>
<td>0.11</td>
</tr>
<tr>
<td>5</td>
<td>0.13</td>
<td>0.49</td>
<td>1.19</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>6</td>
<td>0.19</td>
<td>0.50</td>
<td>1.19</td>
<td>0.14</td>
<td>0.15</td>
</tr>
<tr>
<td>7</td>
<td>0.27</td>
<td>0.53</td>
<td>1.10</td>
<td>0.15</td>
<td>0.14</td>
</tr>
<tr>
<td>8</td>
<td>0.41</td>
<td>0.63</td>
<td>1.13</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>9</td>
<td>0.66</td>
<td>0.80</td>
<td>1.07</td>
<td>0.19</td>
<td>0.19</td>
</tr>
<tr>
<td>10</td>
<td>0.89</td>
<td>0.87</td>
<td>1.11</td>
<td>0.16</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Ratio 10/1: 49.3  2.27  0.58  2.82  1.68
Ratio 9/2: 20.6  1.81  0.58  2.69  1.72

Note: Countries are ranked according to GDP per capita and divided among deciles. For each decile, we report: (1) GDP per capita relative to that of the United States (RGDPpc), (2) the price of traditional services relative to the price of GDP ($P_{St}/P$), (3) the price of non-traditional services relative to the price of GDP ($P_{Sn}/P$), (4) the real expenditure share of non-traditional services to GDP ($sQ_{SN}$), (5) the nominal expenditure share of non-traditional services to GDP ($sE_{SN}$).

services. To provide a first pass at the importance of the reallocation within services in explaining the fact that the price of services in higher in rich countries, note that the relative price of services can be decomposed as:

$$
\frac{P_{S}}{P} = \frac{E_{S}/Q_{S}}{P} = \frac{P_{St}}{P} \cdot sQ_{St} + \frac{P_{Sn}}{P} \cdot (1 - sQ_{St}),
$$

where $P_{S}/P$ is the relative price of services (relative to GDP), $P_{Si}/P$ is the relative price of $i$ services (traditional or non-traditional), and $sQ_{St}$ is the real share of traditional services in total services. We then perform the following counterfactual. We ask what the relative price of aggregate services would be if there was no reallocation across services categories (we fix the real share of traditional services to that observed for the United States). We find that
without the reallocation across services, the relative price of services would be essentially the same across rich and poor countries. (See Figure 8). For poorer countries, the relative price of traditional services is low, the relative price of non-traditional services is high, and the weight of non-traditional (expensive) services is low. This reallocation in poor countries compared to rich countries accounts for the low relative price of services.

As alluded to in the introduction, the relative price of aggregate services has often been viewed as informative of the relative productivity of the service sector in poor countries relative to rich countries. We argue that the reallocation within services is critical in making inferences about the productivity of the service sector. In the rest of the paper we work out the details of how heterogeneity in the service sector is important for the implications of sectoral productivity across countries.

3 Development Accounting

To start investigating the importance of reallocation across services categories for sectoral productivity across countries, we follow a large literature in development accounting assessing the productivity implications of price and expenditure data across sectors and countries. More specifically, we ask the following question: What are the productivity implications of disaggregating the service sector?

We closely follow Herrendorf and Valentinyi (2011) in conducting a development accounting exercise that imposes minimal structure. There are three sectors: manufacturing ($m$), traditional services ($s_T$), and non-traditional services ($s_N$). Production in each sector is governed by linear technologies requiring labor input:

$$Y_i = A_i L_i, \quad i \in \{m, s_T, s_N\},$$
where $Y_i$ and $L_i$ are output and labor in sector $i$ and $A_i$ is labor productivity in sector $i$. Notice that, given our assumption of the production function for each sector, data on labor productivity across sectors and countries can directly pin down the variables of interest, i.e., $A_i$ for all countries and sectors. However, such data does not exist, at least for a comprehensive set of sectors and for a large number of countries. The main difficulty is that what is available is the value of labor productivity across sectors and countries and these values can reflect differences in relative prices across sectors within a country as well as differences in relative prices across countries, potentially confounding true differences in real productivity. In addition, even if we could make a mapping from the real expenditure data and output in a sector, generally we will not have the corresponding labor input associated with that sector specification. Hence, more structure is needed before we can identify $A_i$ across sectors and countries using data.

We proceed by assuming, in addition to linear technologies in labor, competitive markets for goods and labor, and perfect factor mobility across sectors. With these assumptions, the value of labor productivity (the marginal product of labor in this case) is equalized across sectors. The stand-in firm in each sector maximizes profits by choosing an appropriate amount of labor, which requires $p_iA_i = w$ for all $i$, where $w$ is the wage rate and $p_i$ is the price of output in sector $i$. Normalizing the total amount of labor in each country to 1, we have that $\sum_i L_i = 1$. Then, it follows that the value of aggregate output is $\sum_i p_iY_i = w$ and that the labor input is determined by the share of value output,

$$L_i = \frac{p_iY_i}{\sum_i p_iY_i}.$$

Then, productivity in each sector and country is given by the ratio of output to labor with the labor inferred from the share value of output,

$$A_i = \frac{Y_i}{sE_i},$$
Table 3: Development Accounting Results

<table>
<thead>
<tr>
<th></th>
<th>( A_i )</th>
<th>( m )</th>
<th>( s )</th>
<th>( s_T )</th>
<th>( s_N )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income elasticity</td>
<td>–</td>
<td>1.11</td>
<td>0.87</td>
<td>0.79</td>
<td>1.15</td>
</tr>
<tr>
<td>( D_{10} )</td>
<td>0.89</td>
<td>0.86</td>
<td>0.94</td>
<td>1.04</td>
<td>0.80</td>
</tr>
<tr>
<td>( D_5 )</td>
<td>0.13</td>
<td>0.08</td>
<td>0.23</td>
<td>0.31</td>
<td>0.12</td>
</tr>
<tr>
<td>( D_1 )</td>
<td>0.02</td>
<td>0.01</td>
<td>0.03</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>Ratio ( D_{10}/D_1 )</td>
<td>49.3</td>
<td>79.2</td>
<td>27.8</td>
<td>21.0</td>
<td>80.5</td>
</tr>
</tbody>
</table>

where \( sE_i = L_i = \frac{\sum p_i Y_i}{\sum p_i} \).

To implement this development accounting empirically, we assume that the real expenditure data \( (Q_i) \) represents sectoral output in the model \( (Y_i) \) and that the share of nominal expenditure \( (sE_i = E_i/E) \) represents the share value of output in each sector in the model.

We report the results of the development accounting exercise in Table 3. For each sector and country, we calculate labor productivity \( (A_i) \) and calculate statistics to illustrate how sectoral productivity varies with GDP per capita in the cross country data. We compute the income elasticity by regressing the log of \( A_i \) on log GDP per capita, and by calculating the average \( A_i \) for countries in different deciles of the income distribution.

We emphasize the following results from Table 3:

1. When services are aggregated, we find that the cross-country variation in manufacturing productivity is larger than in services productivity as reflected in the larger income elasticity in manufacturing than services. A one percent higher income per capita translates into a 1.12 percent higher productivity in manufacturing productivity whereas only a .85 percent higher productivity in services. For the ratio of the 10 percent richest and poorest countries, differences in manufacturing productivity are close to 67-fold while for services they are 21-fold. These results are consistent with the findings in the related literature such as Hsieh and Klenow (2007), Herrendorf and
Valentinyi (2011) and the literature emphasizing productivity differences between the tradable and non-tradable sectors (e.g. Kravis, et al.).

(2) When the service sector is disaggregated between traditional and non-traditional, the accounting results are markedly different in that the traditional sector features lower differences in productivity than manufacturing, which are critical in determining the implications for aggregate services (since traditional services are almost all the services in poor countries and still more than 60 percent in rich countries). In turn, the non-traditional services look more like manufacturing in terms of the cross country differences in productivity. In fact, using the income elasticity as a summary indicator of differences in productivity across countries, non-traditional services feature a larger elasticity than manufacturing.

The stark implied differences in productivity between traditional and non-traditional services is relevant for development since development involves a reallocation to non-traditional services. Depending on the factors that drive the reallocation across services, the sectoral differences in productivity may constitute an obstacle to development or affect negatively aggregate productivity. We turn next to this issue by considering a model of the structural transformation in services.

4 Quantitative Analysis

While the development accounting just discussed provides estimates of the sectoral differences in productivity that are consistent with the price and expenditure data across sectors and countries, development accounting is silent about the forces driving differences in sectoral quantities in the cross-country data. In this section, we investigate the sectoral productivity implications in a standard model of reallocation with three sectors: manufacturing, traditional services, and non-traditional services.
4.1 Description

The model is a general equilibrium model of the structural transformation closely following Duarte and Restuccia (2010). There are three sectors: manufacturing, traditional services, and non-traditional services. We assume homothetic preferences. Reallocation within services is driven by differential productivity growth and non unitary elasticity of substitution as in Ngai and Pissarides (2007).

Production  In each period, three goods are produced: manufacturing \((m)\), traditional services \((s_T)\), and non-traditional services \((s_N)\) with linear technologies in labor,

\[ Y_i = A_i L_i, \quad i \in \{m, s_T, s_N\}, \]

where \(A_i\) is labor productivity and \(L_i\) is total labor hours in sector \(i\).

Preferences  There is a stand-in representative household with preferences over consumption:

\[ u(c_m, c_{s_T}, c_{s_N}) = b \log(c_m) + (1 - b) \log \left[ \phi c_{s_T}^\rho + (1 - \phi) c_{s_N}^\rho \right]^{\frac{1}{\rho}}, \]

with \(b\) and \(\phi\) between 0 and 1 and \(\rho < 1\). Households are endowed with one unit of productive time each period which can be allocated to work in any sector.

Market Structure  We assume that labor and goods markets are competitive and there are no frictions to labor allocation across sectors. This implies that for the household to allocate hours in all sectors, the wage in each sector must be equal and we denote it by \(w\). Given this wage and the price of output, firms in each sector maximize profits by choosing the labor input:

\[ \max_{L_i} p_i A_i L_i - w L_i. \]
Prices are such that markets for output and labor clear.

**Equilibrium** A *competitive equilibrium* is a set of prices \( \{p_m, p_{sT}, p_{sN}\} \) and allocations \( \{c_m, c_{sT}, c_{sN}\} \) for the household and \( \{L_m, L_{sT}, L_{sN}\} \) for firms such that:

1. Given prices, firm’s allocations \( \{L_m, L_{sT}, L_{sN}\} \) maximize profits.

2. Given prices, household’s allocations \( \{c_m, c_{sT}, c_{sN}\} \) maximize utility subject to the budget and non-negativity constraints.

3. Markets clear:
   - Labor market: \( L_m + L_{sT} + L_{sN} = L \).
   - Goods markets: \( c_m = Y_m, \ c_{sT} = Y_{sT}, \ c_{sN} = Y_{sN} \).

**Characterization** From the first order conditions of the firm’s problem, prices of goods in each sector are given by

\[
p_i = \frac{w}{A_i}.
\]

From the first order conditions of the consumers, consumption of traditional and non-traditional services satisfy:

\[
\frac{A_{sN}}{A_{sT}} = \frac{\phi}{1 - \phi} \left( \frac{c_{sT}}{c_{sN}} \right)^{p-1}.
\]

And consumption of services and manufacturing:

\[
\frac{A_m}{A_{sT}} = \frac{b}{1 - b} \frac{c_m}{c_{sT}} \frac{A_{sT}}{A_{sN}}.
\]

Since consumption in each sector must be produced with the linear technologies and aggregate labor equals one, these two equations and the clearing condition for labor determine all the endogenous variables in the model. Moreover, as can be seen from equations (1) and
Table 4: Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target U.S. Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_i$</td>
<td>1.0</td>
<td>Normalization</td>
</tr>
<tr>
<td>$b$</td>
<td>0.48</td>
<td>Share of expenditures in manufacturing</td>
</tr>
<tr>
<td>$\phi$</td>
<td>0.60</td>
<td>Ratio of expenditures $c_{sT}/c_{sN}$</td>
</tr>
<tr>
<td>$\rho$</td>
<td>-0.5</td>
<td></td>
</tr>
</tbody>
</table>

(2), data on real consumption shares are informative about the productivities of the sectors, a fact we exploit in the quantitative application of the model.

4.2 Calibration

We calibrate a benchmark economy with normalized sectoral productivities to 1 to data for the United States. The parameters $b$ and $\phi$ are calibrated to the share of real expenditures in manufacturing and the ratio of traditional to non-traditional services. Ideally, the parameter $\rho$ is calibrated so that the model matches time series for the United States. We are still in the process of collecting the appropriate data to perform this exercise. Nevertheless, as we show in the next subsection, the chosen elasticity $\rho$ makes the model match well the reallocation involved across a set of rich economies that differ from the U.S. data. Calibrated parameters are reported in Table 4.

4.3 Results

We measure sectoral relative labor productivity across countries ($A_m, A_{sT}, A_{sN}$) using the model. We impose three targets:

- shares of real expenditures in manufacturing and traditional services,
The results of the model are summarized in Table 5 together with the results of the development accounting for comparison. Recall that the development accounting matches both quantities and prices, while the model imposes no restriction on prices. Therefore, the accounting results for prices serve as a comparison of the model with data.

We emphasize the following results from the model:

1. For countries in the richest decile, the implications of the model are nearly identical to the ones from the development accounting both in terms of quantities and relative prices. For these countries, productivity differences with the United States are as large in non-traditional services as in manufacturing.

2. For countries in the poorest decile, the productivity implications in the model are similar to the accounting in manufacturing and traditional services. But the productivity differences in non-traditional services are much larger. To put it differently, for the model to reconcile the shares of real expenditures in the data for the poorest countries, productivity in non-traditional services must be very low (an order of magnitude lower than in the accounting).

• relative aggregate labor productivity.
Table 6: Experiments

<table>
<thead>
<tr>
<th>% ↑ GDPpc</th>
<th>Δ((p.p.)sL)_{sN}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(D_{10})</td>
<td>(D_5)</td>
</tr>
<tr>
<td>10% ↑ (A_m)</td>
<td>2.1</td>
</tr>
<tr>
<td>10% ↑ (A_{sN})</td>
<td>2.6</td>
</tr>
</tbody>
</table>

3. A modification of the model is needed to account for the relative price behaviour of non-traditional services in poor countries.

These results reinforce our emphasis that heterogeneity in the service sector is important for productivity implications.

4.4 Experiments

To illustrate the implications of disaggregating the service sector for aggregate productivity growth, we conduct two experiments whereby we increase productivity in the manufacturing sector or the non-traditional service sector by 10% in each case and we conduct these experiments for countries in the richest, poorest and middle deciles of the income distribution. Table 6 reports the results. The results show that an increase in productivity in non-traditional services has a larger impact on aggregate productivity than the increase in manufacturing and this is true for rich and poor countries.

5 Conclusion

A non-trivial and growing subset of services categories feature a falling relative price with income (non-traditional services). A standard development accounting exercise uncovers the importance of disaggregating services for productivity implications. We find that labor
productivity differences in non-traditional services are at least as large as those in manufacturing (the model predicts much larger differences than in manufacturing). The process of development involves a reallocation to non-traditional services which in turn hinges on productivity in that sector. Facilitating development requires solving the productivity problem in non-traditional services in poor countries. Doing so may require policy reforms that are more elaborate than the typical “openness-to-trade” recipe.
References


Herrendorf, Berthold, and Ákos Valentinyi, “Which Sectors Make the Poor Countries so Unproductive?,” *Journal of the European Economic Association*, forthcoming.


A Data Sources and Definitions

A.1 ICP Data

The International Comparison Program (ICP) provides parity and expenditure data for 129 categories for 146 countries for the year 2005. The parity for each category (basic heading) is generated by the ICP based on detailed price data collected in each country. The parity $pp_{ij}$ for each basic heading $i$, $i = 1, ..., m$, in country $j$, $j = 1, ..., n$, is expressed in units of currency of country $j$ to the numeraire currency (the U.S. dollar). The ICP also provides expenditure data, in national currency units, for each basic heading in each country, $E_{ij}$. The expenditure data are obtained from national account systems. Expenditure over all basic headings aggregates to GDP. At the basic heading level, parities allow expenditure data to be converted into a common currency, making it comparable across countries. We convert each country’s expenditure for a basic heading to U.S. dollars by computing notional quantities, defined as $q_{ij} = E_{ij}/pp_{ij}$.

The ICP aggregates basic heading parities and expenditures into higher levels of aggregation (such as GDP) using the Éltető, Köves, and Szulc (EKS) method. Although the EKS is considered the most appropriate method to compare the different aggregates of the GDP across economies, the expenditures by aggregate are not additive to higher levels of aggregation. We aggregate the detailed ICP data using the Geary and Khamis (GK) method, which produces additive results. For the purpose of our paper, additive consistency is an important property because it enables the calculation of shares (e.g., the share of real services in real GDP) and their comparison across countries.\(^6\)

The GK method delivers a set of international prices, $\pi_i$ for each basic heading $i$. The valuation of country $j$’s output in international prices is then $RGDP_j = \sum_{i=1}^{m} \pi_i q_{ij}$. The

\(^6\)Note that computing GDP in country $j$ in a common currency by simply adding up notional quantities for all basic headings would use the relative prices between basic headings that prevailed in the United States, the numeraire country. Hence, the result would not be invariant to the base country.
international price for heading $i$ is defined as

$$\pi_i = \frac{\sum_{j=1}^{n} p_{pij} q_{ij}}{\sum_{j=1}^{n} q_{ij}},$$  \hspace{1cm} (3)$$

where $PPP_j$ is the purchasing power parity over GDP for country $j$, given by

$$PPP_j = \frac{GDP_j}{RGDP_j},$$  \hspace{1cm} (4)$$

where $GDP_j = \sum_{i=1}^{m} E_{ij}$.

The international prices are defined so that they imply a purchasing power parity over GDP for each country that is consistent with the prices. We obtain the international prices $\pi_i$ by iterating on equations (3) and (4), given an initial guess for $PPP_j$. At each iteration we scale the $\pi_i$’s so that the $PPP$ for the United States is 1 and we assume that the parity for net exports is 1.

After computing international prices, we restrict the data set to countries with more than one million inhabitants in 2005. Our restricted data set covers 130 countries.

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Figure 1: Relative Price of Services across Countries

Note: Data for 2005 from ICP. The relative price of service refers to the PPP price of total services relative to the PPP price of GDP.
Figure 2: Share of Services across Countries

Note: Data for 2005 from ICP. The share of service refers to nominal expenditures in total services relative to nominal GDP.
Figure 3: Real Share of Services across Countries

Note: Data for 2005 from ICP. The real share of service refers to real expenditures in total services relative to real GDP. Real refers to expenditures or GDP at international prices.
Figure 4: Relative Price of Traditional Services across Countries

Note: Data for 2005 from ICP. Price of traditional services relative to the price of GDP. Traditional services include ...
Figure 5: Relative Price of Non-traditional Services across Countries

Note: Data for 2005 from ICP. Price of non-traditional services relative to the price of GDP. Non-traditional services include ...
Figure 6: Relative Price of Non-traditional to Traditional Services across Countries

Note: Data for 2005 from ICP.
Figure 7: Real Share of Non-traditional Services across Countries

Note: Data for 2005 from ICP. The real share of non-traditional services refers to real expenditures in non-traditional services relative to real expenditures in total services. Real refers to expenditures at international prices.
Note: The relative price of service is a weighted average of the relative prices of traditional and non-traditional services with the weight being the real share of each time of services. In the counterfactual, we compute the relative price of services for each country using the country relative prices but assuming the real share of traditional and non-traditional services to be the one of the United States.