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Labor Productivity in Peru: 1997-2007

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Abstract

The purpose of this paper was to decompose the changes in labor productivity of the Peruvian economy into the between- and within-sector effects using 39 sectors in terms of production structure for the period 1997-2007. This sectoral level of analysis was contrasted with a similar, although extended, decomposition at firm level using a sample of 7096 formal manufacturing enterprises for the period 2002-2007. At the sectoral level, the evidence shows that the between-sector or reallocation effects dominate most of the changes in labor productivity in the economy. However, at the firm level, the within-sector effects dominate the changes in labor productivity for the sample of formal firms. The role played by the informal sector in the determination of Peruvian labor productivity may explain the differences. On one hand, the informal sector tends to reduce the within-sector effects because of its significant employment share in manufacturing and its low level of labor productivity. On the other hand, the informal sector tends to increase the between-sector effects, given its buffer feature of generating employment in both crisis and boom periods.

Keywords: Labor productivity, between- and within-sector effects, job creation, job destruction

JEL Classification code: J24

Before the financial crisis of 2009, the economic growth performance of Peru was outstanding, compared to other Latin American countries, with an average real gross domestic product (GDP) and urban employment growth rate of 8.3% and 8.7% respectively between 2005 and 2008 (Banco Central de Reserva del Perú – BCRP, 2009). Despite this impressive record, growth in labor productivity during the postliberal reform period (1991-2005) was lower than in East Asian countries and the United States of America. According to the World Bank (2009), the annual average GDP per capita rate of growth during the period was 0.9%, 0.3%, 2.7%, and 1.8% for Peru, Latin America and the Caribbean (LAC), East Asia, and the United States of America respectively.[1]

By 2007, labor productivity[2] (or GDP per worker) in Peru was lower than in other middle-income (large, medium, and small) LAC countries, such as Brazil, Argentina, Mexico, Colombia, Chile, and Costa Rica (Rodríguez & Tello, 2009). Production and trade structures have not changed over 40 years despite a variety of economic crises (domestic and international) and development strategies (inward and outward) between 1970 and 2011. Thus, Peruvian GDP relates mainly to primary activities (e.g., agriculture, fishing, and minerals) and light manufacturing industries with a lower degree of processing and services (Tello, 2009). Exports continue to reflect a concentration on primary products. In 2007, primary exports represented 84% of the total export value, and mining products represented 62% (BCRP, 2009).

Understanding the dynamism of labor productivity and its effects on production and trade structure in Peru required an analysis of the dynamics of labor productivity by sector and by firm. In the case of Peru,

a lack of data series at the sectoral and micro (i.e., firm or worker) levels had previously limited research in this area. Fortunately, at the beginning of the 1990s, data became available in some developing countries (including Peru), which encouraged extensive literature on new theoretical models and methodologies for the microanalysis of labor productivity and structural changes in production.

This paper involved analyzing the new data available for Peru on two levels to describe the dynamics of labor productivity in Peru between 1997 and 2007. Two subperiods were evident: a deceleration or recession period (1997-2001) of slow GDP economic growth and decreasing terms of trade[3] and an acceleration or boom period (2002-2007) with relatively high GDP and growth in rates of terms of trade.[4] At the sectoral level, this paper illustrates the changes in employment, value added, and labor productivity between 1997 and 2007 and reflects a shift-share sectoral decomposition analysis (developed by Chenery, Robinson, & Syrquin, 1986) of labor productivity.

In contrast to previous results (e.g., Timmer & De Vries, 2009), the analysis indicated that in boom and recession periods, the reallocation of employment between sectors rather than changes in labor productivity within sectors primarily explained changes in labor productivity in the Peruvian economy. However, improved labor productivity in the manufacturing sector during the boom period (2002-2007) has been more important than growth of labor productivity in the services (e.g., household and education services, hotels, and restaurants) and agricultural sectors, which reflect low levels of labor productivity. Conversely, during the recession period (1997-2001), the decline in labor productivity in some low-productivity services sectors and the agricultural sector (when taking differences between average and marginal labor productivity into account) has been more significant in explaining the decrease in labor productivity of the economy than has the decline in labor productivity in the manufacturing sector.

At the firm level, the focus of this paper was on the estimation of the effects of the reallocation of employment upon labor productivity dynamics for a sample of 7096 medium- and large-sized firms from the formal manufacturing sector. In the boom period, the within-firms effect played a more critical role in the rate of growth of labor productivity in the sample of manufacturing firms than did the reallocation of employment between manufacturing branches, particularly in the case of firms that decreased their level of employment.

This paper used two sets of data. One was the *National Households Survey* (*Encuesta Nacional de Hogares* – ENAHO), available since 1997, and the other was the *National Economic Survey of the Manufacturing Sector* (*Encuesta Económica Anual del Sector Manufacturero*), which included data for the period 2002-2007. The National Institute of Statistics and Information (Instituto Nacional de Estadística e Informática – INEI) provided the second set of data, and the first and GDP figures at the sectoral level can be found in INEI (2010b) and INEI (2010a), respectively.

The paper contains four sections. First section is a brief literature review. Then, the next section describes the methodology, data, and data sources. Another section presents the results, and last section provides a summary of the main findings of the paper.

Literature Review

Recurrent acceleration and deceleration phases of growth over relatively short periods (e.g., 10 years) rather than a sustainable and positive economic growth trend over long periods are more common in developing than in developed countries. Concentrating on features of acceleration and deceleration growth episodes may provide more information on the economic development and growth process in less developed economies than would focusing on the average economic growth over longer periods in these economies (Prichett, 2000). Parallel to the change in the focus on the economic growth process, economic developers and growth researchers resumed the tradition evident in the contributions of Chenery et al. (1986) to single out the importance of sectoral development patterns and changes in composition in affecting labor and total factor productivity, which eventually may lead to economic growth. Timmer and De Vries (2009) and Jones and Olken (2008) argued that sectoral labor reallocation caused by differences in labor productivity may be associated with the up and down periods of per capita GDP growth of an economy. In addition, Temple and Woessmann (2006) showed the significance of structural change in generating growth (through changes in total factor productivity) by the reallocation of labor towards sectors with higher marginal productivity.[5]

Garavito (2008), Iguiñiz and Barrantes (2004), and Yamada (2004) noted that literature on Peruvian labor productivity, at the sectoral level, and estimates of sectoral productivity over relatively long periods has

been scanty. Among the most relevant studies is the work of Timmer and De Vries (2009). Using different data sources, Timmer and De Vries estimated the sectoral contribution on the average annual GDP per worker rate of growth between 1960 and 2005. In their study, GDP reflected four sectors: agriculture, manufacturing, market services (including wholesale and retail trade and transport, communication, and financial services), and nonmarket services (including community, social, personal, and government services).

Timmer and De Vries (2009) decomposed the change of GDP per worker into two effects: within-sector and between-sector. The within-sector or intrasector effects measured the contribution to the overall growth of the economy in terms of labor productivity as a result of the changes in labor productivity within each sector. A positive within-sector effect meant that labor productivity had increased during the period, whereas a negative figure indicated that labor productivity had decreased. The shift or between-sector effects measured the contribution to the overall growth of the economy in terms of labor productivity as a result of the changes in labor share in each sector. A negative shift effect showed that sectors with an increasing share of employment had lower labor productivity than did sectors with a decreasing share. In other words, labor moved from sectors with high labor productivity to sectors with lower labor productivity. A positive value indicated that labor moved from sectors with lower labor productivity to sectors with higher labor productivity.

Timmer and De Vries (2009) found that in recession periods with relatively high levels of decreasing GDP per worker growth, all Peruvian sectors decreased their respective GDP per worker level. In recession periods with low levels of decreasing GDP per worker growth, the sectors that contributed the most to the reduction of GDP per worker were manufacturing, market, and nonmarket services. In both cases, the within-industry effect explained most of the variation in GDP per worker. However, in boom periods, all the sectors grow, but manufacturing and market services are the sectors that contribute the most.

A second relevant study is the *World Development Report* (World Bank, 2008). The report indicated that in urbanized countries, such as Peru,[6] between 1993 and 2005, the agricultural sector (which includes hunting and forestry) contributed in a higher proportion to the increase in labor productivity than did the nonagricultural sector, whereas the agricultural employment growth rate was lower than the respective rate in the nonagricultural sector. Consistent with this result, Martin and Mitra (2001) had reported a higher total factor productivity rate of growth for the agricultural than for the manufacturing sector between 1967 and 1992 for the Peruvian economy.

The literature on the dynamic of productivity at the level of firms, although extensive, has been concentrated, on the one hand, upon total factor productivity rather than on firms' labor productivity, and on the other hand, on economies with availability of longitudinal data, mostly from developed countries (e.g., Bartelsman & Doms, 2000; Foster, Haltiwanger, & Krizan, 2001, 2006). Most of the evidence in developed countries shows (a) the extent of dispersion in productivity across production units, firms, or establishments is large; (b) the productivity rank of any unit in the distribution is highly persistent; and (c) a large fraction of aggregate productivity growth is the consequence of worker reallocation across firms.

Studies for developing countries, particularly Latin American countries, are scanty and concentrated on Chile, Colombia, and Mexico. These studies (Blyde & Iberti, 2010; Eslava, Haltiwanger, Kugler, & Kugler, 2004, 2009; Liu, 1993; Liu & Tybout, 1996; Pavcnick, 2002; Tybout, 1992, 2000, 2003; Tybout & Roberts, 1997) showed (among other results) that entering businesses are more productive than incumbents and that exiting businesses are much less productive than incumbents. On the other hand, they found that an important share of aggregate productivity growth in both developed and developing countries arises from the reallocation of resources across plants of different productivity levels.

Chacaltana (2008), Chang (2007), and Villarán (2007) presented some minor evidence at the firm level for Peru. All three authors reported that output value per worker was positively related to firm size. Thus, large firms exhibited a higher level of output per worker than did small firms. In the boom period of 2002 to 2007, the rate of employment growth also varied positively with firm size (i.e., large firms created jobs at higher rates than did small firms).

In this regard, a contribution of the present paper is that it provides new evidence at the firm level of the effect of the reallocation of resources on the labor productivity of the manufacturing sector.

Methodology and Data Sources

This paper uses two methodologies: one at the level of sectors and the other at the level of firms. These are presented in turn.

Methodology for Sectors

At the sectoral level, this paper estimates Peruvian labor productivity throughout the recession and boom periods between 1997 and 2007 for 39 sectors of the Peruvian economy. The basis of the estimates is the employment data from the ENAHO survey for the period. The labor force includes workers aged 14 and over, who (a) worked at least one hour (not including homework hours) of the week prior to the survey, (b) did not work during that week but had fixed employment, (c) owned a business in which they worked at least one hour, or (d) performed an activity for at least one hour to obtain monetary and/or nonmonetary compensation (including people who helped relatives without receiving compensation).[7] The estimated employed labor force included employers, wage earners, self-employed people, unpaid family workers, and housekeepers. For each of the 39 sectors, real value added and employment included the formal and the informal sectors.[8]

Two employment measures were estimated. One represented the estimated number of workers employed (L_1), and the other related to full time equivalent employment (L_2), which represented the estimated number of people working 40 hours per week. In general, the estimated number of workers was greater than the number of full time equivalent workers. P_1 signified labor productivity using the total number of workers, and P_2 denoted estimated labor productivity using the number of full time equivalent workers. Because in most sectors, between 1997 and 2007, the number of workers was higher than the number of full time equivalent workers, labor productivity per worker was lower than labor productivity per standardized worker.[9] INEI (2010a, 2010b) was the source of value-added[10] data.

Using traditional methodology, changes in labor productivity for an economy (ΔP_t) include the within-sector or intrasector effects and the between-sector or shift effects, as follows:

$$\Delta P_t = \sum_{i=1}^{N} \Delta P_{it} S_{it0} + \sum_{i=1}^{N} \Delta S_{it} P_{it0};\ N = 39,\ t = 1998\text{-}2007,^{11}$$

$$P_{it0} = 0.5(P_{it-1} + P_{it}),\ S_{it} = L_{it} / L_t \qquad (1)$$

$$S_{it0} = 0.5(S_{it-1} + S_{it}),\ P_{it} = VA_{it} / L_t$$

where VA_{it} is the real valued added (at 1994 dollar prices) of sector i at period t, and S_{it} is the employment share of sector i out of the total employment in period t; and P_{it} is the labor productivity of sector i at period t. Dividing Equation 1 by P_{t-1} produces the rates of growth. The right hand side of this equation has two components. The first is the within-sector effect, and the second component is the between-sectors effect or the effect of reallocation of employment.

Timmer and De Vries (2009) postulated an alternative interpretation of traditional or standard decomposition. They argued that the split between within- and between-sector effects in the standard decomposition is based on the assumption that marginal and average labor productivity in a sector are equal (i.e., labor productivity growth is independent of the changes in employment). Whereas the assumption may hold for short periods and for most sectors in a developing economy, the assumption might not hold in the case of the agricultural sector in which most employees are living in poverty.[12]

Consequently, the existence of surplus labor or disguised employment in the agricultural sector is a typical phenomenon in many countries in the early stages of development (Timmer & De Vries, 2009). As long as marginal productivity is below average productivity, a decline in the number of agricultural workers will raise, by definition, the average labor productivity in agriculture. The difference between average and marginal productivity in agriculture will indicate a within effect, whereas its effect actually arises from the shift of labor in response to new employment opportunities elsewhere in the economy. Thus, part of the within-sector contribution of agriculture should be allocated to the between-sector contribution of other sectors. To accommodate this important shortcoming, the traditional decomposition was modified in the following way. Assuming that

people who leave the agricultural sector are marginal workers with a lower productivity than workers who remain, the adjusted decomposition included the following steps:

1. Estimate the adjusted labor productivity of the workers who remain in the agricultural sector.
2. Estimate a new within-sector effect for agriculture using the adjusted labor productivity.
3. Impute zero to the between-sector effect for agriculture when workers leave; no adjustment is made otherwise.
4. Distribute the remainder of the original within-sector contribution of the agricultural sector across those sectors that expand their labor shares in proportion to their share of total expansion. Here the assumption is that workers who leave the agricultural sector will move to expanding sectors.
5. Impute zero to the between-sector effects of those sectors that shrink their labor share.
6. Finally, assume a ratio of marginal to average labor productivity of (ε =) 0.410 for Peru for the adjusted sectoral labor productivity growth decomposition (estimated by Timmer & De Vries, 2009). The set of adjusted formulas follows:

$$P_{1t} = MP_{1t} / \varepsilon,\ \varepsilon = 0.410;\ i = 1 \text{ is the agricultural sector} \tag{2}$$

$$P^*_{1t} = (VA_{1t-1} + \varepsilon P_{1t-1}\Delta L_{1t}) / L_{1t},\ \text{if}\ \Delta L_{1t} < 0 \tag{3}$$

$$P^*_{it} = P_{1t},\ \text{if}\ \Delta L_{1t} \geq 0$$

$$Pz = \sum_{i \in J} \Delta S_{it} P_{it0} / \sum_{i \in J} \Delta S_{it},\ i \in J\ \text{ if}\ \Delta L_{it} < 0 \tag{4}$$

$$BE_t = \sum_{i \in K} \Delta S_{it} (P_{it0} - Pz),\ \text{when}\ \Delta L_{1t} \geq 0\ \text{and}\ i \in K\ \text{if}\ \Delta L_{it} \geq 0 \tag{5}$$

$$BE_t = \sum_{i \in K} \Delta S_{it} (P_{it0} - Pz) + \sum_{i \in K} \Delta S_{it} (P^*_{1t} - P_{1t-1}) S_{1t0} / \sum_{i \in K} \Delta S_{it},\ \text{when}\ \Delta L_{1t} < 0\ \text{and}\ i \in K\ \text{if}\ \Delta L_{it} \geq 0$$

$$BE_t = 0,\ \text{for}\ i \in J,\ \text{where}\ i \in J\ \text{if}\ \Delta L_{it} < 0$$

$$\Delta P_t = (P_{1t} - P^*_{1t}) S_{1t0} + \sum_{i \neq 1} \Delta P_{it} S_{it0} + BE_t \tag{6}$$

where MP_{1t} is the marginal labor productivity in the agricultural sector; P^*_{it} is the adjusted labor productivity; Pz represents a weighted average of the labor productivity from a set J of shrinking sectors (whose level of employment has decreased); BE_t is the estimated between-sector effect for the set K of expanding sectors and J of shrinking sectors.

Equation 2 represents the labor productivity of the agricultural sector (i = 1) assuming a constant aggregated-employment elasticity value of 0.410 (Timmer & De Vries, 2009). This equation is used to compute the change of the value added for workers who remain in the agricultural sector. Equation 3 represents the estimated labor productivity for agricultural workers who do not leave the sector. Equation 4 represents the average labor productivity of the shrinking sectors, J, that is $\Delta L_{it} < 0$. For these sectors, the between-sector effects are also ascribed zero. Equation 5 represents the between-sector effects of the expanding sectors, K, that is $\Delta L_{it} > 0$, which is adjusted using the average productivity of the shrinking sectors (Pz) and part of the within-sector effects of the workers who leave the agricultural sector ($\Delta L_{1t} < 0$) for expanding sectors. The first component on the right-hand side of Equation 6 is the new adjusted within-sector effect for the agricultural sector. The second component is the within-sector effect for the rest of the sectors, and the third component is the between-sector effect. The between-sector effect for agricultural workers leaving the sector is attributed zero.

Sectoral employment and the real value-added contribution to the rate of growth of the labor force and real value added were computed as follows:

$$\Delta L_t / L_{t-1} = \sum_{i=1}^{39} S_{it-1} \Delta L_{it} / L_{it-1}$$

$$\Delta VA / VA_{t-1} = \sum_{i=1}^{39} S'_{it-1} \Delta VA_{it} / VA_{it-1}$$

$$S'_{it} = VA_{it} / VA_t \tag{7}$$

As shown in Tables 4 and 6 and in contrast to the role of the agricultural sector evident in previous studies, when taking differences between average and marginal labor productivity into account, the agricultural sector contribution to labor productivity is lower than the respective contribution of the nonagricultural sector. Moreover, its contribution is negative. However, the employment contribution of the agricultural sector is positive and higher in the recession period (1997-2001) than in the boom period (2002-2007).

Methodology for Firms: Gross Job Flows and Labor Productivity for a Sample of Manufacturing Firms in Peru

Davis and Haltiwanger (1999) called firms that increased their total (temporary plus permanent) number of workers between any two years *job-creating firms* and firms that decreased their total number of workers between any two years *job-destructing firms*. The methodology of the labor productivity decomposition to measure the contribution of gross job flow (i.e., creation and/or destruction) rates followed that of Foster et al. (2006). The formulas follow:

$$WE_t = \sum_{i \in JC} S_{i0} \Delta P_{it} + \sum_{i \in JD} S_{i0} \Delta P_{it} + \sum_{i \in NC} S_{i0} \Delta P_{it},\ \Delta S_{it} = (S_{it} - S_{i0}),\ \Delta P_{it} = (P_{it} - P_{i0}) \tag{8}$$

$$BE_t = \sum_{i \in JC} \Delta S_{it} \left[P_{i0} - P_0 \right] + \sum_{i \in JD} \Delta S_{it} \left[P_{i0} - P_0 \right] + \sum_{i \in NC} \Delta S_{it} \left[P_{i0} - P_0 \right]$$

$$CTE_t = \sum_{i \in JC} \Delta S_{it} \Delta P_{it} + \sum_{i \in JD} \Delta S_{it} \Delta P_{it} + \sum_{i \in NC} \Delta S_{it} \Delta P_{it}$$

$$NEX_t = \sum_{i \in Ne} S_{it} \left[P_{it} - P_0 \right] - \sum_{i \in Ex} S_{i0} \left[P_{i0} - P_0 \right]$$

$$\Delta P_t = WE_t + BE_t + CT_t + NEX_t,\ t = 2007 \tag{9}$$

Where, WE_t is the effect within firms; BE_t is the effect between firms; CTE_t is the cross-terms effect; NEX_t is the change of productivity derived by entrant and existing firms; P_{it} is the labor productivity of firm i at period t; and S_{it} is the share of employment of firm i of the total sample employment at period t. The sets JC, JD, and NC correspond to firms that created jobs (i.e., $\Delta L_{it} > 0$), destroyed jobs (i.e., $\Delta L_{it} < 0$), and maintained constant the number of jobs (i.e., $\Delta L_{it} = 0$). Ne and Ex represent the set of entering and exiting firms between periods. Only two periods were considered: 2002 and 2007.

WE_t in Equation 8 represents the within-firm component based on firm-level labor productivity changes, weighted by firm initial employment share in the sample. The three terms of WE_t correspond to the three sets of firms, JC, JD, and NC. BE_t in the same equation relates to the between-firm component that reflects changing employment shares, weighted by the deviation of initial firm labor productivity from the initial labor productivity of the sample of firms. The three terms of BE_t correspond to the three sets of firms, JC, JD, and NC. CTE_t in Equation 8 stands for cross terms that indicate whether businesses with large positive changes in labor productivity are more likely to exhibit decreased employment and vice versa. The evidence reported below is consistent with this fact for both types of firms. The last two terms of NEX_t represent the labor productivity contribution of entering (set Ne) and exiting (set Ex) establishments.

Equation 9 of total labor productivity can be transformed in terms of rate of growth by dividing all the components of Equation 8 by 5 (i.e., 2007-2002) and the simple labor productivity average of the sample in period 0, P_0, which is the real value added (in 1994 dollars) per worker in 2002.

The data source used to compute these formulas was the INEI (2007) *National Economic Survey of the Manufacturing Sector* (for the formal sector) for 2002 and 2007.[13] The INEI surveyed mainly medium (between 21 and 49 workers) and large (more than 49 workers) firms. The adjusted sample of 2007 included 7096 firms, of which 558 created jobs, 284 destroyed jobs, and 54 did not change the level of employment between 2002 and 2007; 4185 firms did not report data in 2002 but did in 2007. These firms represented entering firms for the 2007 survey. In contrast, 2015 firms did not report data in 2007 but did in 2002,[14] representing exiting for the 2007 survey. Manufacturing firms in the 2007 sample signified more than 61% of the total value added and 20% of the total employment in the Peruvian manufacturing sector (Rodríguez & Tello, 2009).

Estimation and Results

Tables 1 to 6 and Figures 1 to 7 present the estimates of the dynamic of labor productivity at the sectoral level and Table 7 at the firm level. Tables for the sectoral level cover 39 sectors. Rodríguez and Tello (2009) presented tables for the sectoral level with a smaller number of sectors in a paper that served as background for the World Bank (2011) study on Peruvian labor markets. The analysis of these tables and figures is presented in turn.

Peruvian Labor Productivity at the Sectoral Level, 1997-2007

Table 1 shows the valued-added and employment shares and the relative value added per employed worker for the 39 sectors between 1997 and 2007. Figures 1 and 2 illustrate the dynamics of these variables. Table 2 indicates the sectoral contributions to the average annual rates of growth of the variables.

The rate of growth of real value added (in 1994 US dollars) in the recession period (1997-2001) was 0.99%, and those rates for both measures of employment (i.e., L_1 and L_2) were the same and equal to 2.3%. In the boom period (2002-2007), these rates were 6.05%, 3.56%, and 2.82% respectively. The estimated average rates of growth of labor productivity using workers and standardized workers were -1.35% and -1.38% respectively in the recession period and 2.40% and 3.01% in the boom period. One important distinction between the number of workers and standardized workers observed in Figure 1 is that whereas the former increased over the entire period (1997-2007), the latter decreased during certain periods, specifically between 1997 and 1999 and between 2003 and 2005. Thus, in those periods, the number of people who worked fewer than 40 hours increased.

Table 1 shows that in both periods, the agricultural sector together with the wholesale and retail trade sector and the services sectors (real estate, hotels and restaurants, household services, human health, private education, and government services) employed close to 80% of the total labor force. The manufacturing sector (i.e., from "dairy products" to "rest of manufactures") was the fourth most important sector in terms of employment generation (approximately 9% share). Close to 45% of the manufacturing labor force was employed in the textiles, clothing, and wood and furniture sectors. The four sectors (agriculture, trade, services, and manufactures) with the highest employment share also explain around 70% of the total real value added in both periods.

Concerning labor productivity, the sectors with higher levels of labor productivity were (in order of importance) mining and quarrying, financial services, electricity, and insurance services. The first two sectors decreased their relative labor productivity with respect to the average labor productivity of the economy during the boom period, and the other two sectors increased their relative labor productivity. The differences, in part, can be attributed to the fact that the employment share of electricity and water services and insurance services decreased throughout the entire period (1997-2007). In contrast, the respective employment share of mining and quarrying and financial services responded to the changes in the aggregate demand (external and internal), increasing during the period of expansion and decreasing during the period of recession. At the other end, agriculture was the sector with the lowest level of labor productivity, with its labor productivity relative to the average labor productivity of the economy decreasing during the boom period.

The two sectors with the next lowest labor productivity were the fishing sector and the wholesale and retail trade sector. In contrast to the agricultural sector, relative labor productivity with respect to the average labor productivity of the economy in these two sectors increased during the boom period. Within the services sector, hotels and restaurants, household services, and private education services exhibited the lowest labor productivity, with their labor productivity being lower than the average labor productivity of the economy.

Table 1
Percentage of Average Annual Value Added and Employment Share and Relative Value Added per Worker by Sector, Peru, 1997-2007

	1997-2001					2002-2007				
Sector	*VA*	L_1	L_2	P_1	P_2	*VA*	L_1	L_2	P_1	P_2
I. Agriculture	9.3	34.0	28.1	27.3	33.2	9.3	36.7	30.7	25.5	30.4
Agriculture, hunting, and forestry	9.3	34.0	28.1	27.3	33.2	9.3	36.7	30.7	25.5	30.4
II. Manufacturing	15.6	9.3	9.5	230.9	236.9	16.1	9.5	9.9	185.3	167.1
Dairy products	0.3	0.1	0.1	253.9	282.9	0.4	0.1	0.1	274.5	280.1
Processed fish meals	0.8	0.2	0.2	564.2	407.2	0.7	0.2	0.2	361.1	300.0
Bakery and grain mill products	1.2	0.9	0.9	133.2	137.6	1.1	0.9	0.9	127.4	120.1
Other food products	2.0	0.4	0.5	519.5	426.9	2.1	0.5	0.6	410.2	338.9
Beverages and tobacco	0.7	0.4	0.4	216.6	216.7	0.7	0.3	0.3	315.7	286.7
Textiles	1.1	1.6	1.2	70.8	92.5	1.2	1.6	1.3	79.2	96.2
Clothing	1.2	1.4	1.4	85.9	91.8	1.2	1.5	1.6	79.0	77.2
Leather products	0.1	0.1	0.1	94.8	101.0	0.04	0.1	0.1	55.6	47.3
Footwear	0.2	0.3	0.4	63.5	60.1	0.1	0.3	0.4	19.3	16.4
Wood and furniture	0.5	1.2	1.3	46.7	42.3	0.5	1.2	1.4	45.6	40.7
Paper products	0.5	0.1	0.1	574.1	454.7	0.6	0.1	0.1	940.6	760.9
Printing materials	0.5	0.3	0.3	189.0	184.0	0.6	0.3	0.4	181.7	158.5
Basic chemicals and pharmaceutical products	0.5	0.1	0.1	3006.3	1980.9	0.6	0.1	0.1	482.0	474.4
Other chemical products	1.0	0.1	0.1	1314.5	1315.9	1.1	0.1	0.1	829.1	764.6
Rubber and plastic	0.5	0.1	0.2	501.3	422.0	0.5	0.2	0.2	315.3	248.9
Nonmetallic minerals	1.2	0.5	0.5	278.5	259.1	1.4	0.4	0.4	375.7	343.0
Iron and steel	0.5	0.02	0.03	5352.0	4320.3	0.5	0.1	0.1	1160.8	876.0
Nonferrous metals	0.9	0.02	0.03	7631.4	13061.1	1.0	0.03	0.03	3888.8	3748.6
Metallic products	0.7	0.7	0.8	108.4	92.2	0.8	0.6	0.7	124.4	110.9
Nonelectrical machinery	0.2	0.1	0.1	368.7	482.4	0.1	0.2	0.2	117.9	103.1
Electrical machinery	0.3	0.1	0.1	476.6	397.8	0.3	0.1	0.1	425.6	336.3
Transport equipment	0.2	0.1	0.1	284.1	244.3	0.2	0.1	0.1	158.7	134.2
Rest of manufactures	0.5	0.5	0.5	106.5	106.8	0.4	0.5	0.5	95.1	96.4
III. Market Services	48.0	41.4	45.7	118.0	108.5	47.3	38.9	42.6	122.4	111.4
Wholesale and retail trade	16.0	19.4	21.6	82.4	74.3	15.8	17.1	19.5	92.2	80.8
Real estate and other contract services to firms	10.5	4.7	5.3	223.6	199.3	10.3	4.5	5.0	228.5	205.9
Private human health services	1.7	1.6	1.5	107.3	115.3	1.7	1.4	1.4	121.0	126.3
Private education services	3.6	4.8	3.8	74.4	94.4	3.4	4.6	3.2	74.1	105.2
Hotels and restaurants	4.4	5.2	5.3	86.4	85.0	4.2	5.4	5.5	77.9	76.9
Transport and communications	8.7	5.3	7.6	165.8	115.6	9.0	5.5	7.6	163.2	117.9
Financial services	2.8	0.3	0.4	1058.8	874.5	2.4	0.3	0.3	837.8	758.7
Insurance services	0.3	0.1	0.2	616.6	426.2	0.5	0.1	0.1	783.7	820.9
IV. Non Market Services	11.4	10.1	11.1	112.2	102.6	11.0	10.1	11.1	111.2	99.7
Household services	4.6	7.1	7.4	64.6	62.1	4.2	7.0	7.5	60.9	56.9
Government services	6.8	3.0	3.7	225.0	183.7	6.8	3.1	3.6	224.8	188.9
V. Other industries	15.7	5.4	5.9	334.5	276.1	16.2	5.1	5.5	341.4	290.3
Fishing	0.6	0.6	0.7	96.8	88.7	0.6	0.6	0.6	104.6	96.5
Mining and quarrying	5.3	0.5	0.6	1158.0	865.1	6.5	0.8	0.9	879.3	724.9
Extraction of crude petroleum and petroleum refineries	1.4	0.1	0.1	2802.0	2152.4	1.2	0.1	0.1	1910.6	1419.2
Electricity and water	2.3	0.3	0.3	906.4	732.4	2.3	0.2	0.2	1152.1	948.1
Construction	6.1	3.9	4.2	158.2	145.9	5.6	3.4	3.7	162.8	149.9
TOTAL[a]	48752.9	11827.4	11464.1	4122.1	4252.7	60477.5	13997.3	13170.8	4320.7	4591.8

Note. The branches of the manufacturing sector include those from dairy products to the rest of manufactures. Estimates based on data from *ENAHO (1997-2007)* by INEI (2010b).

[a] VA in millions of dollars (1994), L_1 and L_2 in thousands of workers, and P_1 and P_2 in dollar per worker.

Table 2
Percentage of Average Annual Growth Rate Contribution to Value Added and Employment Share by Sector, Peru, 1997-2007

	1997-2001			2002-2007		
Sector	*VA*	L_1	L_2	*VA*	L_1	L_2
I. Agriculture	0.4	1.591	1.481	0.38	0.903	0.29
Agriculture, hunting, and forestry	0.4	1.591	1.481	0.38	0.903	0.29
II. Manufacturing	0.09	0.10	0.15	1.21	0.49	0.50
Dairy products	0.03	0.018	0.016	0.04	0.007	0.01
Processed fish meals	-0.01	-0.006	-0.02	0.04	0.007	0.01
Bakery and grain mill products	0.07	0.013	-0.013	0.02	0.018	0.03
Other food products	0.08	0.033	0.05	0.15	0.071	0.08
Beverages and tobacco	0.01	-0.048	-0.056	0.05	0.031	0.02
Textiles	-0.004	-0.058	0.0007	0.09	0.123	0.08
Clothing	-0.03	0.032	0.067	0.06	0.095	0.12
Leather products	-0.01	-0.014	-0.021	0.06	0.012	0.02
Footwear	-0.02	0.012	0.026	-0.02	-0.003	-0.003
Wood and furniture	-0.05	0.016	0.015	0.04	0.021	0.03
Paper products	0.05	-0.005	-0.01	0.07	0.002	0.004
Printing materials	0.001	0.008	0.001	0.06	0.021	0.02
Basic chemicals and pharmaceutical products	0.01	-0.03	-0.043	0.05	0.014	0.01
Other chemical products	-0.02	0.018	0.019	0.1	0.004	0.003
Rubber and plastic	0.04	-0.005	-0.011	0.03	0.009	0.01
Nonmetallic minerals	-0.04	-0.01	0.009	0.15	0.0004	-0.01
Iron and steel	0.002	-0.0004	-0.001	0.05	0.003	0.004
Nonferrous metals	0.04	-0.002	-0.006	0.03	0.003	0.002
Metallic products	0.002	0.079	0.085	0.07	-0.025	-0.03
Nonelectrical machinery	-0.02	0.03	0.031	-0.01	0.023	0.03
Electrical machinery	-0.02	-0.002	-0.005	0.02	0.014	0.02
Transport equipment	-0.01	0.006	0.007	0.03	0.014	0.02
Rest of manufactures	0.03	0.018	0.016	0.04	0.007	0.01
III. Market Services	0.29	0.51	0.54	2.94	1.46	1.32
Wholesale and retail trade	0.02	0.09	0.316	1.03	0.389	0.31
Real estate and other contract services to firms	0.18	-0.12	-0.167	0.52	0.205	0.19
Private human health services	0.08	-0.042	-0.028	0.06	0.083	0.07
Private education services	0.08	0.22	0.194	0.12	0.132	0.02
Hotels and restaurants	0.02	0.315	0.232	0.22	0.233	0.22
Transport and communications	0.07	0.129	0.116	0.73	0.381	0.47
Financial services	-0.18	-0.07	-0.105	0.21	0.032	0.03
Insurance services	0.02	-0.014	-0.015	0.05	0.008	0.01
IV. Non Market Services	0.08	0.33	0.42	0.57	0.37	0.35
Household services	-0.01	0.364	0.534	0.19	0.174	0.12
Government services	0.09	-0.038	-0.116	0.38	0.2	0.23
V. Other industries	0.15	-0.21	-0.28	1.08	0.33	0.35
Fishing	0.01	-0.007	-0.026	0.03	0.023	0.02
Mining and quarrying	0.44	-0.048	-0.059	0.36	0.121	0.14
Extraction of crude petroleum and petroleum refineries	-0.02	-0.004	-0.014	0.06	0.003	0.0
Electricity and water	0.08	-0.032	-0.031	0.13	0.004	0.001
Construction	-0.36	-0.119	-0.149	0.5	0.176	0.19
TOTAL	0.99	2.315	2.314	6.05	3.559	2.82

Note. Estimates based on Table 1.

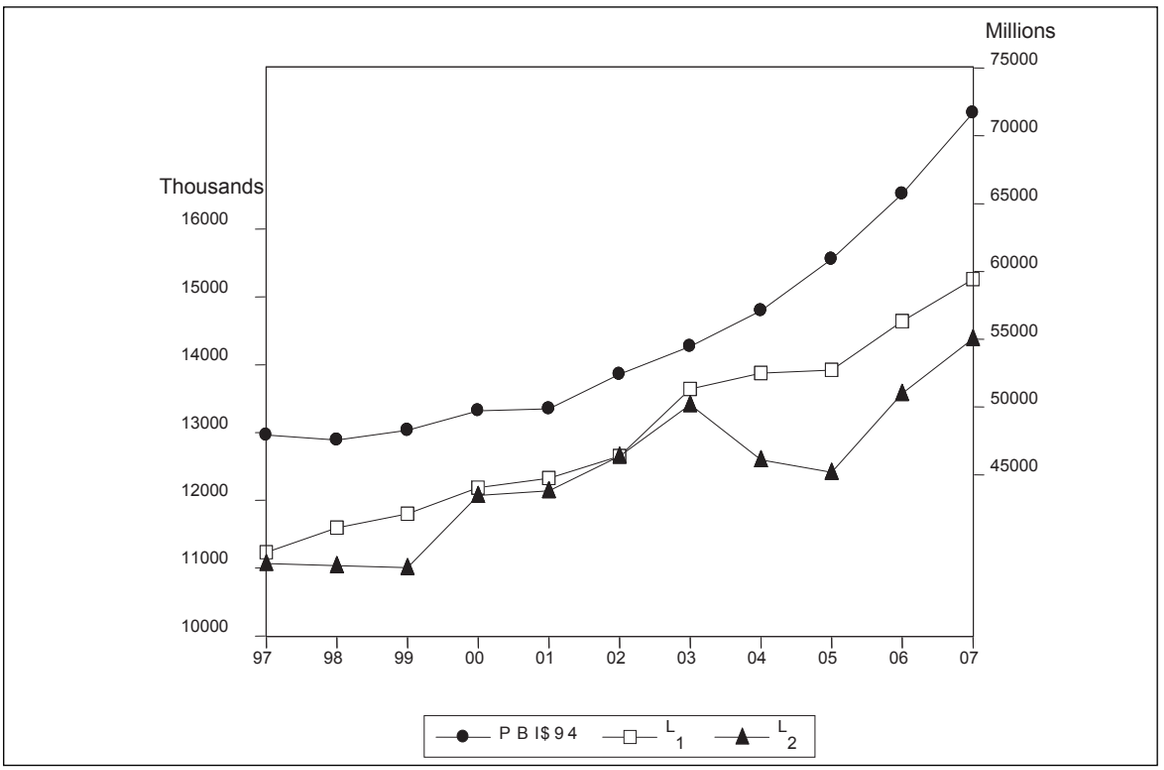

Figure 1. Real value added and employment, Peru, 1997-2007.

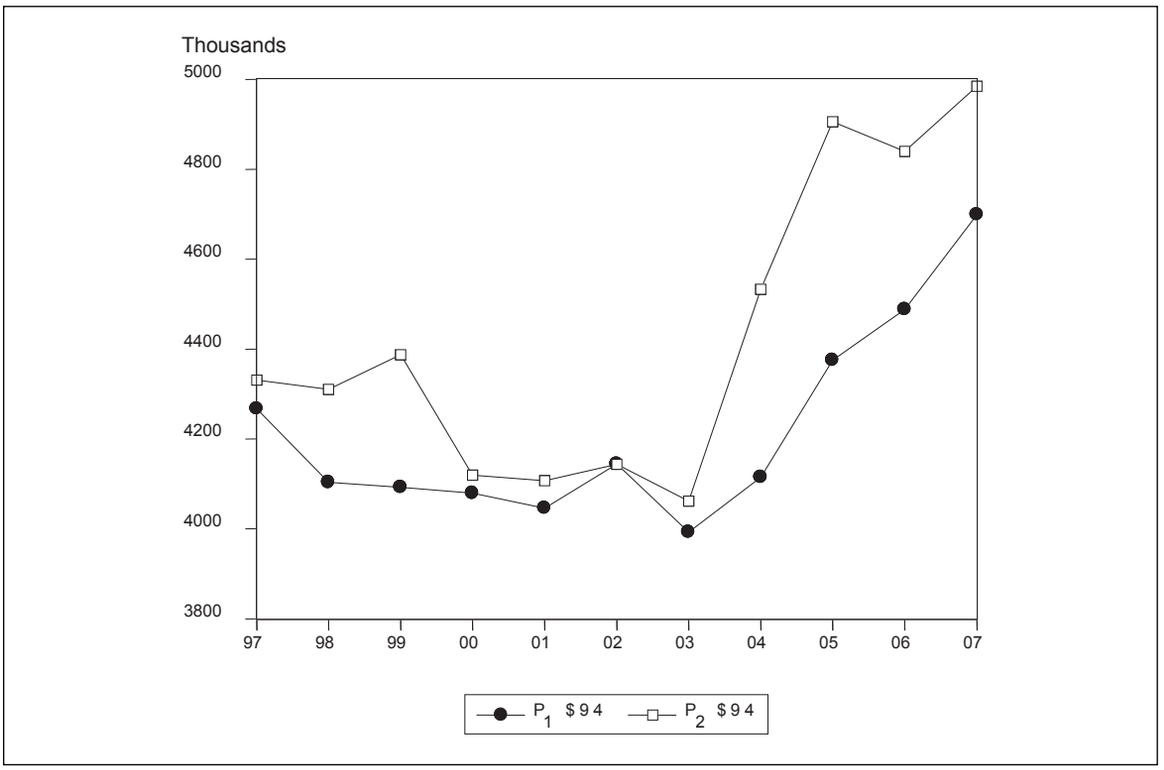

Figure 2. Real value added per employed worker, 1997-2007.

Relative labor productivity in the hotel and restaurant and household services sectors with respect to the average labor productivity of the economy decreased between 2002 and 2007.

In the remaining sectors, the relative level of the labor productivity ratio also differed. The ratio in the manufacturing and construction sectors seemed to increase during the boom period, but the changes in the transport and communications sector were not clear. These latter changes depend upon the measure of the labor productivity indicator. In terms of the number of workers, relative labor productivity decreased during the boom period, but in terms of the number of standardized workers, relative labor productivity increased.

Sector behavior in terms of output, employment, and labor productivity also differed in growth dynamics between 1997 and 2007. In the boom period, the contribution of employment and real output (or value added) of the manufacturing sector was higher than the contribution during the recession period. The finding indicates that this sector (like many others) is very sensitive to changes in aggregate demand: the growth rates in output and employment in this sector were higher than the rates for the economy in the boom period and the reverse in the recession period. Except for the agricultural sector and the mining and quarrying sectors, the same pattern of sectoral contribution of manufacturing industries is apparent among the rest of the sectors (i.e., fishing, transport and communication, construction, electricity, and financial and insurance services) although at different degrees of response to the changes (internal and external) in demand.

In the case of the agricultural sector, the output and employment contribution were higher in the recession than in the boom period. This implies that the growth rates of output and employment in this sector in the recession period were higher than the respective rates for the economy in the boom period. The finding indicates that agricultural workers in the boom period might have moved to other sectors with higher wages and labor productivity or other sectors that reflected new job opportunities resulting from increased demand (both internal and external).

In contrast, the output contribution during the recession period was higher than in the boom period for the mining and quarrying sector, whereas, in terms of employment contribution, the pattern was reversed. The result relates to the fact that during the recession period, the output rate of growth was higher than the average for the economy, whereas the employment rate of growth was negative and lower than the average for the economy. The reverse occurred during the boom period. The difference in output and employment behavior in the mining and quarrying sector shows that employment is more sensitive to changes (external or internal) in demand than is output. Because most of the output from the mining and quarrying sector is exported, the output level seems less sensitive to changes in prices.[15]

Overall, the data for most of the sectors in the Peruvian economy show that, in contrast to the results of Timmer and De Vries (2009), the between-sector effects rather than the within-sector effects largely explain the growth in labor productivity between 1997 and 2007 regardless of the methods or employment figures (workers and standardized workers) used. The difference may lie in the fact that Timmer and De Vries included only the formal sector in their employment estimates, whereas the employment figures reported in this paper include both the formal and informal sectors. The reallocation of resources between the formal and informal sectors may explain the importance of the between-sector effects in the economy.[16]

Tables 3 to 6 show the sectoral contribution of labor productivity and its growth decomposition. For comparison purposes, Tables 3 to 6 use the same five groups of sectors that Timmer and De Vries (2009) used. Tables 3 and 5 indicate the labor productivity growth decomposition by sectors without adjustment due to differences in average and marginal labor productivity in agriculture (i.e., Equation 1), and Tables 4 and 6 illustrate the data for the adjusted decomposition (i.e., Equations 5 and 6).

Three features support the role of the informal sector in the dynamic labor productivity of the Peruvian economy. First, 60% to 70% of the total labor force in Peru works in the informal sector (Maloney et al., 2007; Tello, 2010b). Most of this informal labor force is concentrated in agriculture, trade, services, and manufactures. Second, the level of labor productivity in the informal sector is the lowest in the economy (Rodríguez & Tello, 2009). Third, labor productivity in the informal sector is decreasing while the labor force is increasing (Rodríguez & Tello, 2009). These aspects reduce the within-sector effects and increase the between-sector effects, particularly in productive branches dominated by the informal labor force. Negative between-sector effects in the economy mean that the labor force is moving from high-productivity sectors to low-productivity sectors. Negative between-sector effects for a particular productive sector indicate that the labor share of this sector is shrinking. The opposite occurs at the sector and economy levels when the between-sector effects are positive. A positive (negative) within-sector effect means that at the level of the economy or sector, labor productivity is increasing (decreasing).

Three major differences exist between the standard decomposition and the adjusted decomposition. First, a negative between-sector effect for the agricultural sector may occur even when the sector experiences an expansion in employment (e.g., in the 2002-2007 period). Thus, in any period, when labor moves from shrinking sectors to the agricultural sector (i.e., when employment in the agricultural sector increases). If the average labor productivity in the agricultural sector is lower than the labor productivity of the shrinking sector, labor productivity for the economy will decrease.

Table 3
Percentage of Average Annual Growth Rate Contribution in Value Added per Worker (L_1) by Sector, Peru, 1998-2007

	1998-2001			2002-2007		
Sector	Within sectors	Between Sectors	Total	Within sectors	Between sectors	Total
I. Agriculture	-0.042	0.226	0.184	0.130	-0.096	0.033
Agriculture, hunting, and forestry	-0.042	0.226	0.184	0.130	-0.096	0.033
II. Manufacturing	2.837	-3.124	-0.291	0.018	0.514	0.535
Dairy products	-0.019	0.041	0.022	0.017	0.005	0.022
Processed fish meals	-0.112	0.079	-0.033	0.015	-0.006	0.01
Bakery and grain mill products	0.046	-0.007	0.039	0.000	-0.024	-0.024
Other food products	-0.101	0.14	0.039	-0.133	0.21	0.077
Beverages and tobacco	0.134	-0.14	-0.006	-0.039	0.059	0.021
Textiles	0.034	-0.064	-0.03	-0.006	0.048	0.043
Clothing	-0.055	-0.006	-0.061	-0.017	0.03	0.013
Leather products	0.007	-0.018	-0.012	-0.007	0.004	-0.002
Footwear	-0.028	-0.001	-0.029	-0.017	-0.004	-0.022
Wood and furniture	-0.05	-0.009	-0.06	0.029	-0.011	0.018
Paper products	0.081	-0.036	0.045	0.06	-0.009	0.051
Printing materials	-0.014	0.004	-0.01	0.021	0.017	0.038
Basic chemicals and pharmaceutical products	3.249	-3.28	-0.031	-0.05	0.081	0.031
Other chemical products	-0.136	0.118	-0.018	0.055	-0.001	0.053
Rubber and plastic	0.074	-0.05	0.025	-0.007	0.015	0.008
Nonmetallic minerals	0.001	-0.069	-0.069	0.130	-0.031	0.099
Iron and steel	0.025	-0.034	-0.009	0.008	0.02	0.028
Nonferrous metals	-0.033	0.054	0.021	-0.099	0.096	-0.003
Metallic products	-0.073	0.059	-0.015	0.088	-0.043	0.045
Nonelectrical machinery	-0.11	0.08	-0.03	-0.007	-0.006	-0.013
Electrical machinery	-0.008	-0.018	-0.027	-0.033	0.038	0.005
Transport equipment	-0.042	0.025	-0.017	0.004	0.017	0.021
Rest of manufactures	-0.033	0.008	-0.025	0.006	0.009	0.016
III. Market Services	1.071	-1.908	-0.839	0.674	0.506	1.179
Wholesale and retail trade	-0.052	-0.306	-0.358	0.619	-0.195	0.424
Financial services	0.571	-0.815	-0.245	-0.089	0.21	0.121
Insurance services	0.443	-0.431	0.012	-0.01	0.04	0.03
Real estate and other contract services to firms	0.465	-0.532	-0.067	0.029	0.112	0.141
Private human health services	0.137	-0.095	0.042	-0.037	0.036	-0.001
Private education services	-0.086	0.084	-0.003	0.021	-0.027	-0.007
Transport and communications	-0.144	0.011	-0.134	0.111	0.298	0.409
Hotels and restaurants	-0.263	0.176	-0.086	0.030	0.032	0.062
IV. Nonmarket services	-0.071	-0.111	-0.182	0.025	0.145	0.170
Household services	-0.246	0.132	-0.114	0.078	-0.045	0.033
Government services	0.175	-0.243	-0.068	-0.053	0.19	0.137
V. Other industries	1.306	-1.529	-0.222	-0.59	1.089	0.500
Fishing	0.022	-0.023	-0.001	0.009	0.003	0.012
Extraction of crude petroleum and petroleum refineries	0.075	-0.130	-0.055	-0.006	0.022	0.016

Sector	1998-2001 Within sectors	1998-2001 Between Sectors	1998-2001 Total	2002-2007 Within sectors	2002-2007 Between sectors	2002-2007 Total
Mining and quarrying	0.985	-0.668	0.317	-0.888	1.019	0.132
Electricity and water	0.391	-0.366	0.025	0.092	-0.047	0.045
Construction	-0.167	-0.342	-0.508	0.203	0.092	0.295
TOTAL	5.099	-6.448	-1.349	0.26	2.156	2.417

Note. Estimates based on Table 1.

Table 4

Percentage of Average Annual Growth Rate Contribution in Value Added per Worker (L_1) Adjusted by Difference in Agricultural Labor Productivity by Sector, Peru, 1998-2007

Sector	1998-2001 Within sectors	1998-2001 Between Sectors	1998-2001 Total	2002-2007 Within sectors	2002-2007 Between sectors	2002-2007 Total
I. Agriculture	-0.042	-3.177	-3.220	0.086	-0.489	-0.403
Agriculture, hunting, and forestry	-0.042	-3.177	-3.220	0.086	-0.489	-0.403
II. Manufacturing	2.837	1.298	4.137	0.018	1.092	1.110
Dairy products	-0.019	-0.113	-0.132	0.017	0.010	0.027
Processed fish meals	-0.112	0.178	0.066	0.015	0.032	0.048
Bakery and grain mill products	0.046	-0.139	-0.093	0.000	-0.033	-0.033
Other food products	-0.101	0.116	0.015	-0.133	0.150	0.017
Beverages and tobacco	0.134	-0.084	0.050	-0.039	0.114	0.076
Textiles	0.034	-0.016	0.019	-0.006	-0.060	-0.066
Clothing	-0.055	-0.425	-0.480	-0.017	-0.046	-0.063
Leather products	0.007	-0.115	-0.108	-0.007	-0.014	-0.021
Footwear	-0.028	-0.071	-0.099	-0.017	-0.016	-0.034
Wood and furniture	-0.050	-0.342	-0.392	0.029	-0.031	-0.003
Paper products	0.081	-0.063	0.018	0.060	0.112	0.172
Printing materials	-0.014	0.009	-0.004	0.021	0.002	0.023
Basic chemicals and pharmaceutical products	3.249	1.077	4.326	-0.050	0.163	0.113
Other chemical products	-0.136	0.147	0.012	0.055	0.078	0.133
Rubber and plastic	0.074	-0.025	0.049	-0.007	0.043	0.036
Nonmetallic minerals	0.001	-0.011	-0.011	0.130	0.079	0.209
Iron and steel	0.025	0.763	0.788	0.008	0.126	0.134
Nonferrous metals	-0.033	0.867	0.834	-0.099	0.396	0.298
Metallic products	-0.073	-0.396	-0.469	0.088	-0.012	0.076
Nonelectrical machinery	-0.110	0.013	-0.096	-0.007	-0.035	-0.042
Electrical machinery	-0.008	0.000	-0.008	-0.033	0.053	0.020
Transport equipment	-0.042	-0.023	-0.066	0.004	-0.001	0.002
Rest of manufactures	-0.033	-0.049	-0.082	0.006	-0.018	-0.012
III. Market Services	1.071	-3.364	-2.294	0.674	0.239	0.915
Wholesale and retail trade	-0.052	-0.684	-0.736	0.619	-0.095	0.525
Financial services	0.571	0.164	0.735	-0.089	0.279	0.191
Insurance services	0.443	-0.037	0.406	-0.010	0.096	0.086
Real estate and other contract services to firms	0.465	-0.025	0.440	0.029	0.107	0.136
Private human health services	0.137	-0.323	-0.186	-0.037	-0.007	-0.044
Private education services	-0.086	-0.370	-0.457	0.021	-0.019	0.001
Transport and communications	-0.144	-0.993	-1.137	0.111	0.058	0.170
Hotels and restaurants	-0.263	-1.096	-1.359	0.030	-0.180	-0.150
IV. Nonmarket services	-0.071	-0.828	-0.899	0.025	0.032	0.058
Household services	-0.246	-0.842	-1.088	0.078	-0.061	0.018
Government services	0.175	0.014	0.189	-0.053	0.093	0.040
V. Other industries	1.306	-0.380	0.927	-0.590	1.325	0.735
Fishing	0.022	-0.297	-0.275	0.009	-0.001	0.008

Sector	1998-2001 Within sectors	1998-2001 Between Sectors	1998-2001 Total	2002-2007 Within sectors	2002-2007 Between sectors	2002-2007 Total
Extraction of crude petroleum and petroleum refineries	0.075	0.107	0.182	-0.006	0.127	0.121
Mining and quarrying	0.985	0.000	0.985	-0.888	0.930	0.042
Electricity and water	0.391	0.000	0.391	0.092	0.202	0.294
Construction	-0.167	-0.190	-0.356	0.203	0.067	0.270
TOTAL	5.099	-6.448	-1.349	0.216	2.200	2.417

Note. Estimates based on Table 1.

Table 5

Percentage of Average Annual Growth Rate Contribution in Value Added per Worker (L_2) by Sector, Peru, 1998-2007

Sector	1998-2001 Within sectors	1998-2001 Between Sectors	1998-2001 Total	2002-2007 Within sectors	2002-2007 Between sectors	2002-2007 Total
I. Agriculture	-0.113	0.282	0.170	0.272	-0.170	0.102
Agriculture, hunting, and forestry	-0.113	0.282	0.17	0.272	-0.17	0.102
II. Manufacturing	1.447	-1.735	-0.286	0.113	0.521	0.632
Dairy products	-0.017	0.038	0.021	0.004	0.02	0.024
Processed fish meals	-0.047	0.012	-0.035	0.003	0.01	0.013
Bakery and grain mill products	0.07	-0.034	0.037	-0.015	0	-0.015
Other food products	-0.154	0.19	0.036	-0.117	0.209	0.091
Beverages and tobacco	0.14	-0.146	-0.006	-0.02	0.045	0.026
Textiles	-0.007	-0.023	-0.03	0.017	0.033	0.05
Clothing	-0.086	0.028	-0.058	-0.029	0.051	0.022
Leather products	0.017	-0.028	-0.011	-0.007	0.005	-0.002
Footwear	-0.034	0.006	-0.028	-0.016	-0.005	-0.021
Wood and furniture	-0.048	-0.009	-0.058	0.025	-0.004	0.021
Paper products	0.128	-0.085	0.043	0.045	0.008	0.053
Printing materials	-0.003	-0.007	-0.01	0.024	0.017	0.041
Basic chemicals and pharmaceutical products	1.89	-1.92	-0.03	-0.033	0.069	0.036
Other chemical products	-0.159	0.142	-0.017	0.066	-0.008	0.058
Rubber and plastic	0.056	-0.032	0.024	-0.001	0.013	0.012
Nonmetallic minerals	-0.04	-0.027	-0.067	0.159	-0.053	0.106
Iron and steel	0.105	-0.114	-0.009	-0.006	0.036	0.03
Nonferrous metals	-0.015	0.035	0.02	-0.042	0.047	0.005
Metallic products	-0.066	0.051	-0.014	0.095	-0.045	0.049
Nonelectrical machinery	-0.212	0.183	-0.028	-0.006	-0.006	-0.012
Electrical machinery	0.005	-0.031	-0.026	-0.047	0.053	0.006
Transport equipment	-0.048	0.032	-0.016	0.001	0.021	0.021
Rest of manufactures	-0.028	0.004	-0.024	0.013	0.005	0.018
III. Market Services	1.232	-2.082	-0.847	1.023	0.462	1.485
Wholesale and retail trade	-0.223	-0.132	-0.354	0.713	-0.191	0.522
Financial services	0.74	-0.98	-0.24	-0.058	0.193	0.135
Insurance services	0.415	-0.403	0.011	0.002	0.033	0.034
Real estate and other contract services to firms	0.528	-0.601	-0.073	0.084	0.127	0.211
Private human health services	0.106	-0.069	0.038	-0.018	0.03	0.012
Private education services	-0.107	0.102	-0.005	0.101	-0.084	0.018
Transport and communications	-0.04	-0.098	-0.137	0.163	0.299	0.462
Hotels and restaurants	-0.187	0.099	-0.087	0.036	0.055	0.091
IV. Nonmarket services	-0.045	-0.145	-0.189	0.079	0.165	0.244
Household services	-0.335	0.219	-0.115	0.111	-0.048	0.063
Government services	0.29	-0.364	-0.074	-0.032	0.213	0.181
V. Other industries	1.366	-1.596	-0.230	-0.389	0.991	0.604

Sector	1998-2001			2002-2007		
	Within sectors	Between Sectors	Total	Within sectors	Between sectors	Total
Fishing	0.036	-0.038	-0.002	0.006	0.009	0.015
Extraction of crude petroleum and petroleum refineries	0.203	-0.257	-0.055	0.016	0.006	0.022
Mining and quarrying	0.914	-0.61	0.304	-0.731	0.908	0.177
Electricity and water	0.358	-0.335	0.023	0.125	-0.065	0.061
Construction	-0.145	-0.356	-0.5	0.195	0.133	0.329
TOTAL	3.888	-5.272	-1.383	1.098	1.97	3.068

Note. Estimates based on Table 1.

Table 6

Percentage of Average Annual Growth Rate Contribution in Value Added per Worker (L_2) Adjusted by Difference in Agricultural Labor Productivity by Sector, Peru, 1998-2007

Sector	1998-2001			2002-2007		
	Within sectors	Between sectors	Total	Within sectors	Between sectors	Total
I. Agriculture	-0.115	-1.575	-1.690	0.196	-0.492	-0.296
Agriculture, hunting, and forestry	-0.115	-1.575	-1.69	0.196	-0.492	-0.296
II. Manufacturing	1.447	2.486	3.931	0.113	1.048	1.161
Dairy products	-0.017	-0.087	-0.104	0.004	0.022	0.026
Processed fish meals	-0.047	0.104	0.057	0.003	0.031	0.034
Bakery and grain mill products	0.07	0.022	0.092	-0.015	-0.014	-0.029
Other food products	-0.154	0.152	-0.002	-0.117	0.134	0.017
Beverages and tobacco	0.14	-0.067	0.073	-0.02	0.069	0.049
Textiles	-0.007	-0.127	-0.134	0.017	-0.034	-0.017
Clothing	-0.086	-0.393	-0.479	-0.029	-0.046	-0.075
Leather products	0.017	-0.112	-0.095	-0.007	-0.019	-0.027
Footwear	-0.034	-0.074	-0.108	-0.016	-0.033	-0.049
Wood and furniture	-0.048	-0.29	-0.338	0.025	-0.026	-0.001
Paper products	0.128	-0.075	0.053	0.045	0.136	0.181
Printing materials	-0.003	0.016	0.013	0.024	0.005	0.029
Basic chemicals and pharmaceutical products	1.89	1.053	2.943	-0.033	0.159	0.126
Other chemical products	-0.159	0.253	0.094	0.066	0.065	0.131
Rubber and plastic	0.056	0.05	0.105	-0.001	0.024	0.023
Nonmetallic minerals	-0.04	0.015	-0.025	0.159	0.064	0.224
Iron and steel	0.105	0.735	0.84	-0.006	0.105	0.099
Nonferrous metals	-0.015	1.47	1.455	-0.042	0.41	0.368
Metallic products	-0.066	-0.275	-0.341	0.095	-0.011	0.083
Nonelectrical machinery	-0.212	0.212	0	-0.006	-0.033	-0.038
Electrical machinery	0.005	-0.005	0	-0.047	0.058	0.011
Transport equipment	-0.048	-0.015	-0.063	0.001	-0.001	0
Rest of manufactures	-0.028	-0.076	-0.105	0.013	-0.017	-0.004
III. Market Services	1.232	-4.199	-2.964	1.023	0.310	1.334
Wholesale and retail trade	-0.223	-1.636	-1.858	0.713	-0.033	0.68
Financial services	0.74	0.216	0.957	-0.058	0.295	0.237
Insurance services	0.415	-0.079	0.335	0.002	0.107	0.109
Real estate and other contract services to firms	0.528	-0.042	0.487	0.084	0.111	0.195
Private human health services	0.106	-0.175	-0.068	-0.018	0.012	-0.006
Private education services	-0.107	-0.275	-0.382	0.101	-0.007	0.095
Transport and communications	-0.04	-1.567	-1.607	0.163	-0.017	0.146
Hotels and restaurants	-0.187	-0.641	-0.828	0.036	-0.158	-0.122
IV. Nonmarket services	-0.045	-1.722	-1.767	0.079	-0.036	0.042
Household services	-0.335	-1.752	-2.087	0.111	-0.084	0.027

Sector	1998-2001			2002-2007		
	Within sectors	Between sectors	Total	Within sectors	Between sectors	Total
Government services	0.29	0.03	0.32	-0.032	0.048	0.015
V. Other industries	1.366	-0.259	1.105	-0.389	1.219	0.829
Fishing	0.036	-0.437	-0.401	0.006	-0.004	0.001
Extraction of crude petroleum and petroleum refineries	0.203	0.2	0.402	0.016	0.15	0.166
Mining and quarrying	0.914	0.003	0.917	-0.731	0.821	0.089
Electricity and water	0.358	0.015	0.372	0.125	0.163	0.289
Construction	-0.145	-0.04	-0.185	0.195	0.089	0.284
TOTAL	3.886	-5.269	-1.383	1.022	2.047	3.068

Note. Estimates based on Table 1.

Using the traditional methodology, an expansion of employment in the agricultural sector contributes positively to labor productivity of the economy because labor productivity in agriculture is assumed constant when labor reallocates from other sectors to the agricultural sector.

Second, the within-sector effect of the agricultural sector would be reduced, compared with the traditional methodology, only if employment in the agricultural sector decreased (e.g., in 2001-2002). This was not the case for the number of workers during the 1998-2001 period. Third, between-sector effects for nonagricultural sectors with the adjusted methodology will be higher (e.g., manufactures and electricity and water, 2002-2007) or lower (e.g., mining and quarrying, 2002-2007) than the effects of the traditional method depending on changes in agricultural sector employment and differences between labor productivity of a particular nonagricultural sector and average labor productivity of shrinking sectors.

Considering these differences, the sector data in the tables indicate that in the boom period, the between-sector effects for the agricultural and the wholesale and retail trade sectors were negative, regardless of the employment measures used. The effect may indicate that in such a period, workers from these sectors moved to other sectors because the sectors exhibited new job opportunities and/or higher wages and labor productivity. In the case of the adjusted decomposition, as indicated earlier, the higher level of the negative between-sector effects of the agricultural sector was due to the lower level of labor productivity of workers in this sector compared to the other sectors. The within-sector effect for those two sectors was positive, indicating that labor productivity may have increased in these two sectors during this period.[17] The increases, however, may well be at a lower rate than the increase in labor productivity of the economy implied by the lower relative level of labor productivity in this period.

In contrast, in the recession period, both within-sector effects (traditional and adjusted) were negative in the same two sectors, meaning that the annual average level of labor productivity decreased. However, whereas the traditional between-sector effect was positive, the adjusted between-sector effect was negative. The within-sector effect indicates that the agricultural and the wholesale and retail trade sectors acted as a buffer in hard times and absorbed labor from other sectors of the economy. Nevertheless, the effect is short rather than long term, given that in the boom period, the (traditional) within- and between-sector effects reverted. The between-sector effects indicate that despite higher employment rates of growth in the recession than in the boom period, labor productivity levels in the agricultural and the wholesale and retail trade sectors were still lower than the average labor productivity of the rest of the sectors, in particular those in which labor share decreased during the recession period.

The hotel and restaurant, household, and private education services sectors reflected similar decomposition patterns to the agricultural and the wholesale and retail trade sectors in both periods as is evident in Tables 3 to 6. According to the relationship between labor productivity and employment, the rest of the sectors exhibited two types of behavior. In the first group of sectors (e.g., mining and quarrying, financial, human health, and government services), when labor productivity was inversely related to employment in recession and boom periods, the within-sector effect was negative in the boom period (2002-2007) and positive in the recession period (1997-2001). Thus, labor productivity decreased in the boom period and increased in the recession period. However, the employment level of these sectors increased in the second period compared to the first period (i.e., the sign of the between-sector effects was opposite to the sign of the within-sector effects). In the second group of sectors (e.g., most branches of manufacturing and the construction, transport, and communications sectors), when labor productivity and employment were positively related in both periods, the

within- and between-sector effects were negative in the recession period and positive in the boom period. Further, in some branches of manufacturing, the between-sector effects were negligible.

A special sector is electricity and water, which reflected a negative relationship between employment and labor productivity and low employment and real value-added shares in relation to the total labor force and GDP.[18] Between 1997 and 2007, the level of labor productivity increased, whereas the level of employment decreased constantly. The positive average rate of growth of employment in the boom period did not compensate for the high and negative rates during the recession period. Growth decomposition of labor productivity indicated that the within-sector effect was positive in both periods and that the shift effect was negative in both periods regardless of the level of employment (L_1 or L_2). In the adjusted decomposition case, all these effects were nonnegative in both periods, indicating either those workers with low labor productivity were leaving the sector or that workers with high labor productivity had been recruited to the sector.

Sectoral Differences in Labor Productivity Behavior and the Cyclical Behavior of the Peruvian GDP Per Capita, 1997-2007: Some Hypotheses

Taking into account that the labor force estimates included both formal and informal employment, some hypotheses for the sectoral differences in the dynamic behavior of labor productivity and employment between 1997 and 2007 may be plausible. The first type of sectoral behavior exhibits the feature of being highly sensitive to changes in aggregate (internal and external) demand. Manufacturing, construction, and, to a lesser extent, the trade sector are representative of this kind of sector (see Figures 3 to 5 for labor productivity dynamics). In such sectors, labor productivity was positively associated with employment because of the procyclical behavior of the installed capacity utilization rate,[19] the absence of substantial change in total factor productivity, and changes in firms in technical, economic, and/or organizational efficiency.

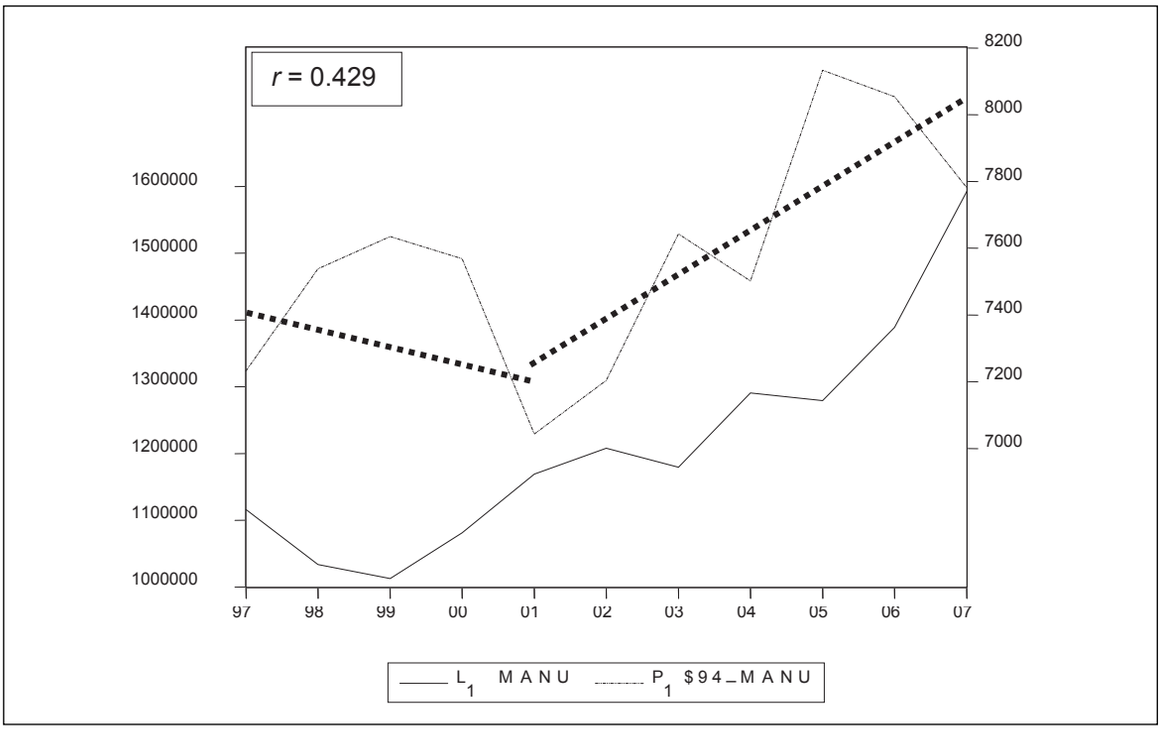

Figure 3. Labor productivity and employment in the manufacturing industry, 1997-2007.

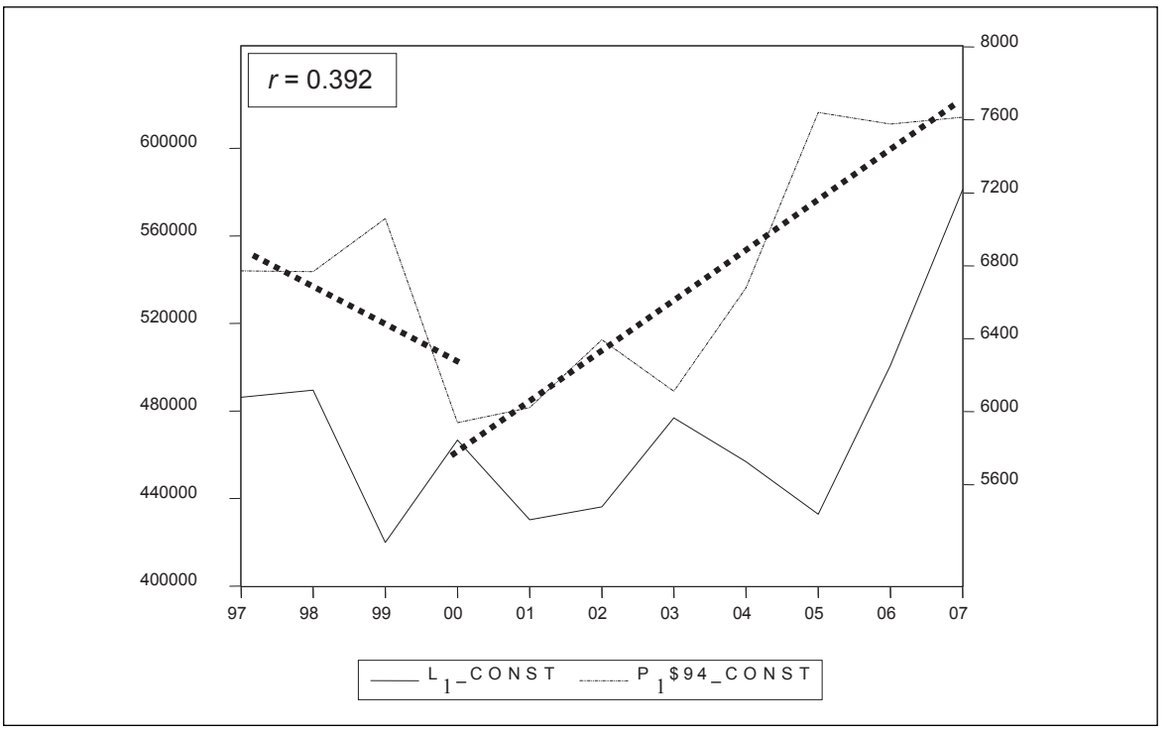

Figure 4. Labor productivity and employment in construction, 1997-2007.

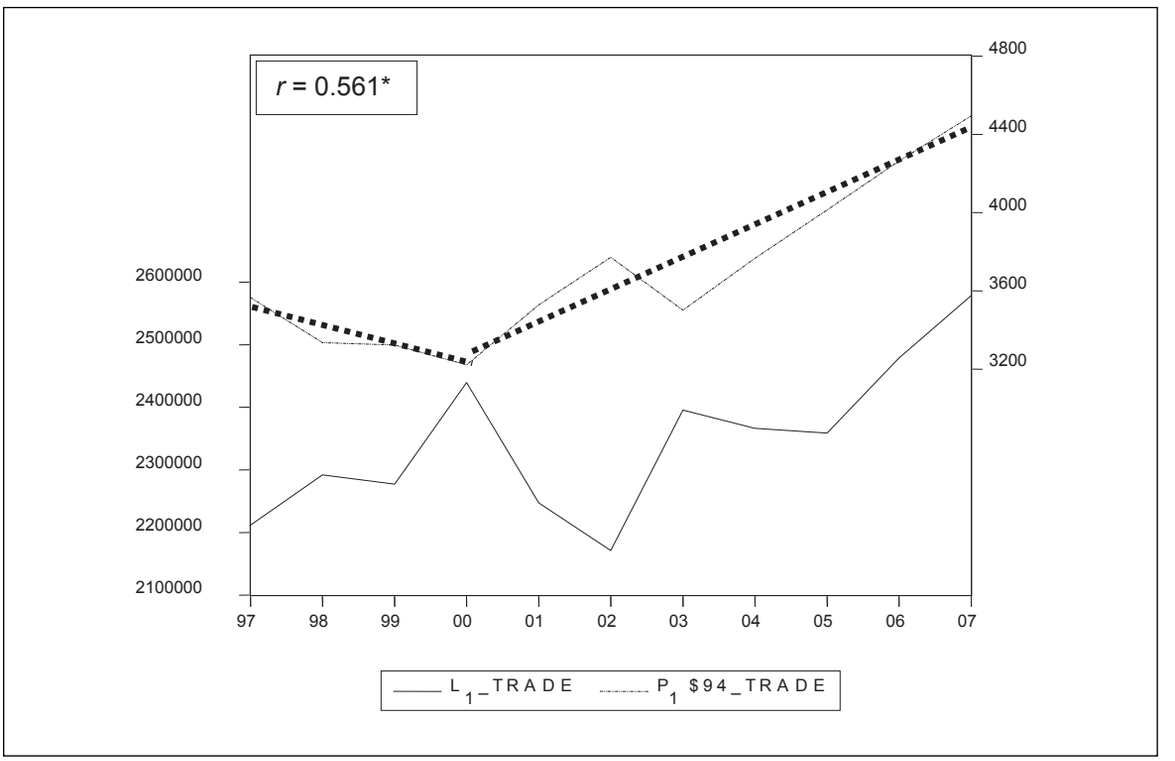

Figure 5. Labor productivity and employment in trade, 1997-2007.

According to Ministerio de la Producción (2009) and INEI (2007), the installed capacity utilization rate in the manufacturing sector decreased from 65.3% in 1997 to 53.8% in 2001 and then increased to 58.7% in 2007.[20] Thus, when the installed capacity utilization rate is less than 100% (i.e., the current level of output

is lower than the potential output), as demand increases, firms may have the propensity to hire more workers to take advantage of the idle plant capacity. Consequently, as utilization of the capacity increases, labor productivity may well increase. Employment in the manufacturing sector increased in the boom period because of employment growth in microenterprises (informal sector) and medium- and large-sized firms (formal sector), but an increase in labor productivity in the formal manufacturing sector was due to a higher installed capacity utilization rate and efficient use of plant capacity by firms that reduced their level of employment (Tello, 2010a). The fact that the installed capacity utilization rate was lower than 100% for both the total manufacturing sector and for a sample of medium and large firms from the formal manufacturing sector may indicate the absence of substantial change in the total factor productivity in this sector.

Although labor productivity reflects procyclical behavior, sectors such as services[21] illustrate a negative correlation coefficient with respect to employment. Most of the services labor force works in the informal sector, which exhibited a positive trend in employment during both the recession and boom periods.[22] In the recession period, labor productivity decreased as a result of a decline in production as aggregated demand fell, and employment increased because the labor force relocated to the informal sector. During the boom period, higher production as aggregate demand increased generated rising labor productivity and employment. Figure 6 shows the labor productivity dynamics of the sector.

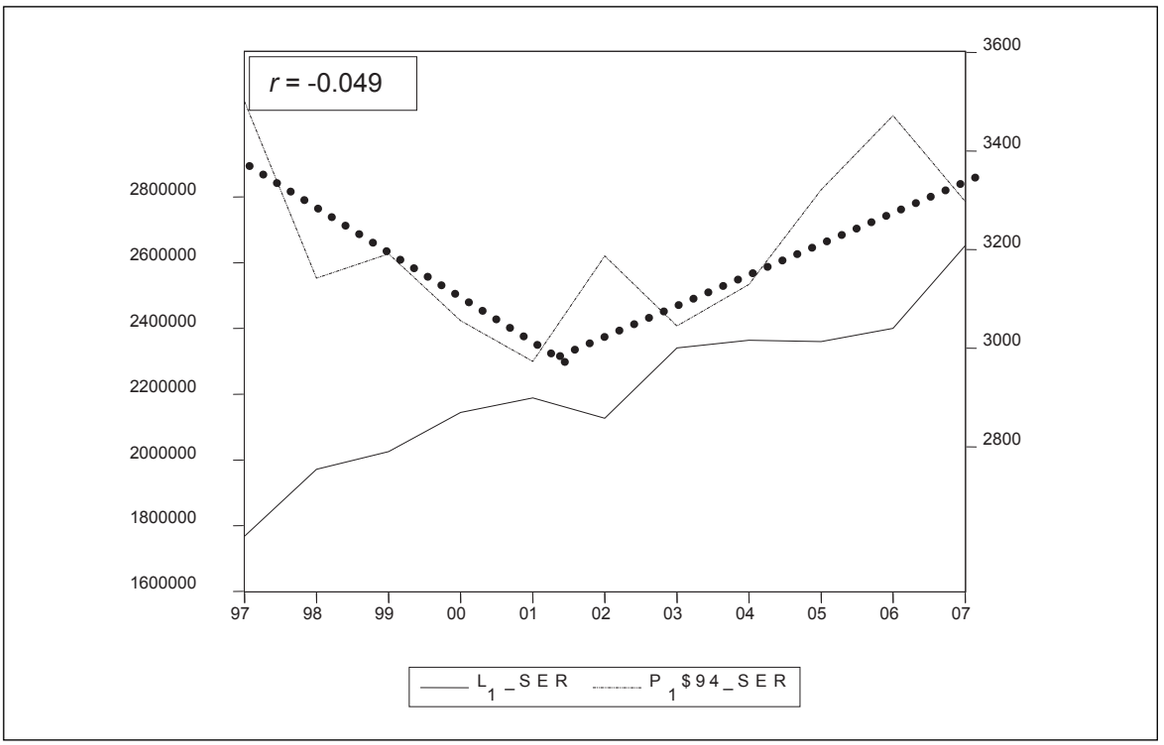

Figure 6. Labor productivity and employment in services, 1997-2007.

The second type of sectoral labor productivity behavior comes from sectors that work at full capacity and that increase output through a higher level of investment or an intensive use of fixed factors. In this type of sector (e.g., mining), a negative relationship between labor productivity and employment was evident. Figure 7 shows the labor productivity dynamics of the sector.

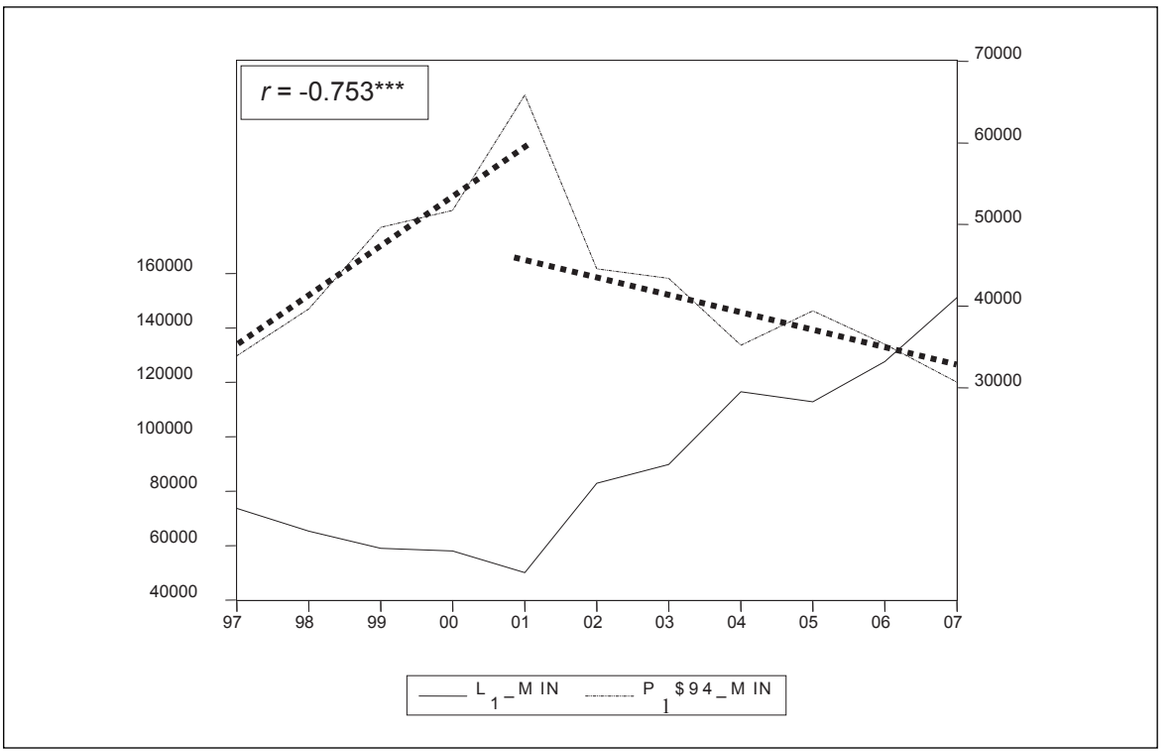

Figure 7. Labor productivity and employment in mining, 1997-2007.

Some stylized facts may support the behavior hypothesis of this sector:

1. Investment in the mining sector dropped from an average of $1252 million (1998-2001) to $880.7 million (2002-2006; Ministerio de Energía y Minas - MINEM, 2004, 2006).
2. Real value-added growth rate of the mining sector decreased from 7.3% (1998-2001) to 5.9% (2002-2007; see Table 2) despite the increasing rate of growth of mining prices from 1.6% (1998-2001) to 20.7% (2002-2007).
3. Employment growth rate increased from -9.0% (1998-2007) to 22% or 19% in terms of standardized workers (2002-2007).

Thus, in the presence of fixed factors, labor productivity would be inversely related to employment level. In this type of sector, employment is procyclical, and labor productivity responds to the cycle of investment. Labor productivity increased in the recession period because of higher levels of investment and lower levels of employment, and decreased in the expansion period because of lower levels of investment and higher levels of employment.

The third type of behavior may result from positive changes in the total factor productivity of a sector. The modern electricity sector may exhibit such behavior (see Figure 8).

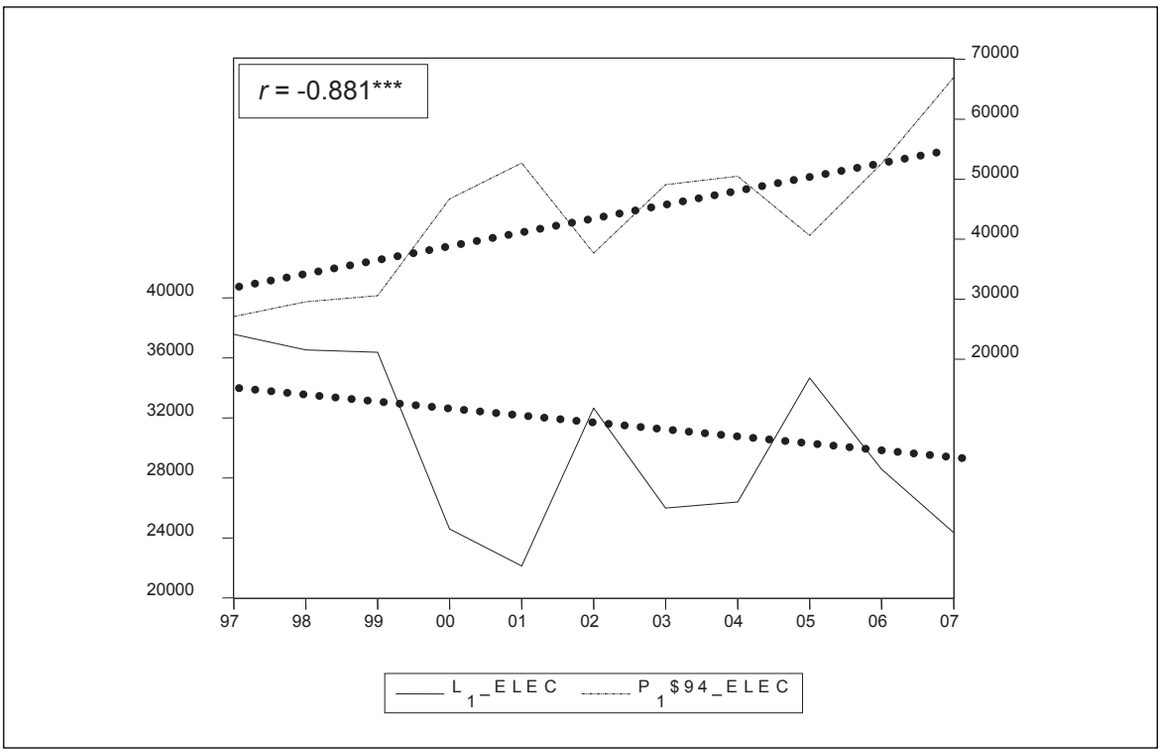

Figure 8. Labor productivity and employment in electricity and water, 1997-2007.

Whereas investment in this sector[23] dropped from an average of $596 million (1997-2001) to $387 million (2002-2007),[24] the installed power per worker (in megawatts per worker) rose from 2.8 in 1998 to 2.93 in 2006 (at an annual average rate of growth of 0.6% between 1998 and 2006) with an annual average employment rate of growth of 0.4% (1998-2007). The rates of growth[25] of physical output of the formal and informal electricity sector were 5.4% and 6.1% in the recession and boom periods respectively and for employment were -18.4% and -4.7%. The respective rates for the water sector were 0.6% and 0.2% for output and -10.7% and -1.6% for employment. The physical output rates of growth for the compound (formal and informal) electricity and water sectors were 3.3% and 5.4% and for employment were -14.5% and -2.6%. While the output growth of this compound sector was dominated by the rate of growth of electrical sector output, employment changes were evident for both the electricity and water sectors. The sustainable labor productivity growth in this sector between 1997 and 2007, despite the decreasing rate of investment in the modern electrical sector and employment in both the formal and informal electrical and water sectors, may be explained by an increased total factor productivity related to structural reforms apparent in the electrical sector since the early 1990s (MINEM, 1998, 2008).

The fourth type of behavior refers to the low-productivity agricultural sector (or traditional agriculture and microfarms oriented primarily to the production of nontradeable goods; Tello, 2011) and the informal sector.[26] Figure 9 and Table 2 show that the employment trend in these sectors was positive regardless of the cyclical behavior of the GDP per worker of the economy. However, the labor productivity trend was negative regardless of the cyclical behavior of the GDP per worker of the economy.

Figure 9 illustrates the dynamics of the agricultural sector, to include the informal, traditional microfarm sector and the modern large-sized firm (mainly agro-exporters) sector. Whereas the average growth rate of the export value of the agro-exporter (traditional and not traditional) sector between 1998 and 2003 was 0.5%, the rate between 2004 and 2007 was 24.9%. The higher rate of growth may explain the higher rate of growth of the real value added per worker in the agricultural sector in that period. For the recession period, up to 2003, the low growth of the export value of the agricultural sector and the probable negative rate of growth of labor productivity of the informal and microfarm sectors may explain the decreasing rate of labor productivity.

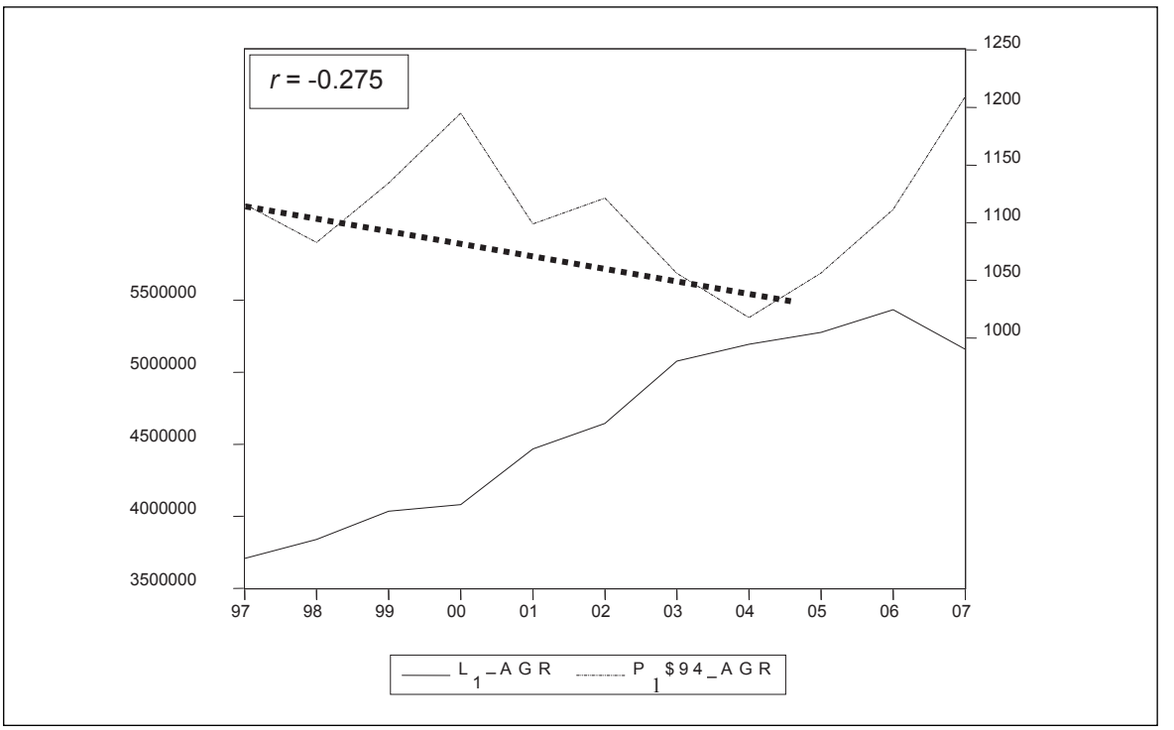

Figure 9. Labor productivity and employment in agriculture, 1997-2007.

Summing up, the evidence of sectoral differences in terms of dynamic behavior of output, employment, and labor productivity and their contribution to the rate of growth of labor productivity in Peru between 1997 and 2007 may indicate the causes of the cyclical and low performance of the GDP per worker. In recession periods (e.g., 1997-2001), the decreasing trend of GDP per worker relates to:

1. the decreasing trend and low labor productivity sectors, such as traditional agriculture, wholesale trade and retail, household services, and the informal sector as a whole; and,
2. the decreasing trend of labor productivity in the formal and informal sectors that are highly demand sensitive, such as manufacturing, construction, and transport and communications.

Of a total decreasing rate of growth of -1.349% of GDP per worker, these sectors[27] contributed -1.325%.

In expansion periods, the formal firms in the same sectors explain the increasing trend of GDP. Labor productivity of relatively small-sized sectors (e.g., mining) and low levels of labor productivity in the informal sector and microfarms in the agricultural sector (labor productivity behavior opposite to those highly sensitive to internal demand) did not compensate for the increased rate of labor productivity in demand-sensitive sectors but reduced the rate of change in the economy's labor productivity. Changing the cyclical behavior of the Peruvian GDP per worker over relatively short periods would require reforms to transform the productive structure to absorb the labor force of the informal and traditional agricultural sectors and generate a continuous sustainable positive rate of growth of total factor productivity in all sectors of the economy, regardless of internal or external shocks.

Results for Firms: Labor Productivity Decomposition for a Sample of Formal Manufacturing Firms in Peru, 2002-2007

The previous analysis indicated the important role of reallocation of employment between sectors in determining the rate of growth of labor productivity in the Peruvian economy in both the recession and boom periods. In the case of the manufacturing sector, in the boom period, such reallocation effects explained close to half the rate of growth in labor productivity. The sector disaggregates into 23 manufacturing branches (see Tables 1 to 6[28]); in 61% (14) of the branches, the effects of reallocation contributed positively to the rate of labor productivity in these branches, and in 57% (13) of the branches, the within-branch effect was positive. In

addition, in that period, labor productivity increased in 19 of 23 branches. Based upon the National Economic Survey of Manufactures (INEI, 2007), the focus of this section is on the effects of reallocation within those 23 International Standard Industrial Classification (ISIC) branches of the manufacturing sector. The section further includes estimates of the dynamics of labor productivity among a sample of medium- and large-size firms in the formal manufacturing sector analogous to the decomposition estimated in the previous section to measure the effect of job flows on labor productivity.

Table present the estimates of labor productivity decomposed by gross job flows for a sample of formal manufacturing firms between 2002 and 2007 following the methodology of Foster et al. (2006) described in the previous section.

Table 7
Labor Productivity Rate of Growth Decomposition for a Sample of Firms from the National Economic Survey of Manufacturing in Peru, 2002-2007 (%)

	Within effects			Between effects			Cross term			Entering	Exiting	
Sector	JC	JD	NC	JC	JD	NC	JC	JD	NC	firms	firms	Total
Universe simulated from sample of formal firms	2.575 (558)	3.726 (284)	0.1120 (54)	0.0919 (558)	0.225 (284)	0.0074 (54)	-0.201 (558)	-0.470 (284)	-0.011 (54)	3.194 (4185)	-5.282 (2015)	14.531 (7096)
		6.4125			0.3247			-0.682			-2.088	
Universe (formal and informal firms)		0.903			0.861							1.764

Note. JC - job-creating firms, JD - job-destructing firms, NC - firms with no change in level of employment.

The data in Table 7 indicates, first, that the rate of growth in labor productivity among large formal firms in the survey (i.e., 14.5%) was much higher than the rate for the total (formal and informal) manufacturing sector (i.e., 1.8%). Thus, the growth of labor productivity in the informal sector, composed mainly of microenterprises (10 or less workers), during the boom period was lower than the average for the manufacturing sector. Second, job-destroying firms contributed more to the growth in labor productivity than did job-creating firms on both components (i.e., within- and between-subsector effects). The firms' within-sector effect explained 44% of labor productivity growth in the sample and the between-sector effect explained 2.2%. Third, the contribution to labor productivity of firms that did not create or destroy jobs was negligible (0.8%).

Fourth, the negative cross-term effect for the three types of firms is consistent with the findings of Tello (2010a): job-creating firms decreased labor productivity, and job-destructing firms increased labor productivity. For firms that did not change their level of employment (i.e., $\Delta S_{it} < 0$), the negative cross terms as well as the positive within-sector effect show that these firms slightly increased their level of labor productivity. Fifth, the last two terms indicate that entering firms in 2007 had a higher level of productivity than the average of the sample from 2002 and that their contribution to labor productivity growth was positive. Exiting firms had a lower level of productivity than the average of the sample from 2002. Their decreased level of labor productivity illustrated a positive contribution to labor productivity growth in the sample. Finally, the formal firms' within-sector effect (6.4%) was much higher than the same effect for the entire manufacturing sector (0.963%), and conversely, firms' between-sector effects (0.32%) were lower than the same effect for the entire manufacturing sector (0.861%).

The role of the informal sector in determining the labor productivity of the economy may explain the result. According to Rodríguez and Tello (2009), in 2007, the informal sector generated 36% of employment among manufacturers. Therefore, the declining labor productivity of microenterprises in the informal sector and the low rate of growth of labor productivity in small formal firms[29] have neutralized the increases in labor productivity among large and medium-sized formal manufacturing firms. The difference in growth of labor productivity between formal large and medium-sized firms and small firms and microenterprises in the formal and informal sectors (given the employment share of the informal sector) may clarify the reduction in within-sector effects for the manufacturing sector. Then again, the reallocation or between-sector effects were greater for the entire manufacturing sector because in the sample of firms, reallocation occurred within branches of the manufacturing industry, whereas in sectoral reallocation, labor mobility occurred between manufacturing and the other sectors in the economy. Given the expansion of demand-driven sectors in boom

periods (such as 2002-2007), once again, the significant size of employment in the informal sector and its labor reallocation to other more productive sectors tended to increase the between-sector effects for the entire manufacturing sector.

Conclusions and Final Remarks

This paper presented new evidence at the sectoral and firm levels on the dynamics of labor productivity in Peru for the periods of 1997-2007 and 2002-2007 respectively. At the sectoral level, and in contrast to previous results (e.g., Timmer & De Vries, 2009), in both periods (1997-2001 and 2002-2007), the reallocation of employment between sectors rather than changes in labor productivity within sectors seemed to explain changes in labor productivity in the Peruvian economy. Improvement in labor productivity in the manufacturing sector during the boom period (2002-2007) was more important than growth in labor productivity in some services sectors with low labor productivity (e.g., household services, education services, and hotels and restaurants) and the agricultural sector. Conversely, during the recession period (1997-2001), the decline in labor productivity in some services sectors with low productivity and the agricultural sector (when taking the difference between marginal and average labor productivity into account) was more important in explaining the decrease in the labor productivity of the economy than the decrease in labor productivity in the manufacturing sector.

Based on data from the National Economic Survey of Manufactures (INEI, 2007) for 2002 and 2007, at firm level, within-sector effects of job-creating formal firms contributed to the rate of growth of labor productivity. However, the main contribution was evident in job-destructing firms. The rate of growth in labor productivity of formal medium-sized and large firms rather than of informal microenterprises and/or small formal firms mainly explained the rate of growth in labor productivity of the manufacturing sector during the boom period.

The evidence presented in this paper on both the sectoral and firm levels leads to two plausible conclusions for economic policy. The first relates to the cyclical behavior of the Peruvian GDP per capita. This cyclical behavior seems to be associated with the Peruvian production structure of the last 50 years and with the sectoral differences in labor productivity among sectors, which with an absence of continuous and sustainable positive changes in total factor productivity of the sectors produce the cyclical behavior of the GDP per capita. Thus, regardless of the short-term internal or external shocks that the Peruvian economy may face in the future, long-term structural reforms oriented to change the production structure and to achieve a continuous and sustainable total factor productivity growth in all sectors of the economy are necessary[30]. Concentration upon short-term tailored economic policies to address external or internal crises will not change the cyclical behavior of the economy.

The second conclusion relates to the role of the informal sector. Structural changes in productivity derived from long-term policies need to incorporate the informal and low-productivity agricultural sectors into the transformation of productivity.[31] The reforms need to move beyond issues of the legal status of the informal sector or land property rights.[32]

Endnotes

1 Similarly, the total factor rate of growth in productivity during the postliberal reforms was lower than in Asian countries and the United States of America (Blyde & Fernández-Arias, 2005). By 2005, GDP (in 2000 US$) per worker for Peru was $5,242, with the average for LAC, East Asia, and the United States being $9,660, $8,190 and $72,524 respectively.

2 Labor productivity is the ratio of real GDP or value added over employed labor force. Note that GDP per worker is a fraction of the value output per worker. Physical output per worker, in economic theory, depends upon the capital labor ratio, other tangible factors per worker, and total factor productivity. Consequently, changes in labor productivity may be associated with changes in total factor productivity, capital labor ratios, and changes in other tangible factors per worker.

3 The average annual rate of change of GDP (in 1994 US$) was close to 1% and for the terms of trade was -4.4%.

4 The rates were 6% and 9.1% respectively.

5 Linked to this is a renewed interest in the development patterns of particular sectors, such as agriculture (Gollin, Parente, & Rogerson, 2002; World Bank, 2008) and manufacturing (Imbs & Wacziarg, 2003; Jones & Olken, 2008).

6 Urbanized countries (e.g., LAC, European, and Central Asian countries) are countries with an average share of the agricultural sector value added out of total GDP of around 5% and with approximately 18% labor share out of total employment.

7 The ENAHO questions used for the employment estimates were p513t, i513t, p520, p507, p501, p502, p503, p504-11, p204, p205, p206, and p208a.

8 Rodríguez and Tello (2009) presented estimates of the size of the urban informal sector of Peru in the boom period (2002-2007) in terms of value added and employment.

9 In some sectors (e.g., electricity and water), people may have worked overtime and more than the 40 hours a week; in these cases, L_2 was higher than L_1, and $P_1 < P_2$.

10 Value added does not include direct or indirect taxes.

11 The operator $\Delta P_t = P_t - P_{t-1}$

12 In the case of Peru, in 2007, the agricultural sector (including forestry and hunting) contributed close to 9% of the total value added of the economy and provided employment to 34% of the labor force (i.e., the highest labor share among the sectors analyzed in this paper). Small productive units perform most of the activities in this sector, using around 23% of the total land cultivated in the sector to produce products for export. Moreover, most of the families in the agricultural sector and rural areas are living in poor conditions (Tello, 2008).

13 The original sample sizes of firms participating in the INEI survey were 5039 and 7872 for 2002 and 2007 respectively. Firms with missing data and data errors were eliminated to produce the sample sizes shown in Table 7.

14 The adjusted sample of firms in 2002 was 2915.

15 Prices in this sector increased only 1.6% between 1998 and 2001, and output 7.3%, whereas between 2002 and 2007, the price increase was 20.7% and the output increase 5.9%.

16 Saavedra, Chong, and Galdo (2001) showed that the employment growth in the informal sector resulted mainly from the growth of labor allocation in these traditionally informal sectors and to a lesser extent from the growth of informality within these sectors.

17 The average labor productivity of the whole trade and retail sector increased between 2002 and 2007. However, the average decreased in the agricultural sector. During this period, labor productivity decreased between 2002 and 2004 and increased between 2004 and 2005. The higher productivity in this period overcompensated for the lower productivity between 2002 and 2004 so that the within-sector effect in the agricultural sector between 2002 and 2007 was positive, which is consistent with the positive rate of growth in the boom period.

18 2.3% in real value-added share and 0.3% in employment share (see Table 1).

19 The installed capacity utilization rate measures the percentage of output produced in comparison to the potential output when all production factors are fully employed.

20 If Y/L = LP = TFP.F(θv), Y is the output level, v = V/L (θ is the installed capacity rate, and θ is between zero and one), where V is the vector of primary factors, and v is the vector of primary factors per worker. F (θv) is a function of the installed capacity coefficient θ times the vector of primary factors -per worker ratio (v). Maintaining constant total factor productivity (TFP), LP will increase (or decrease) even if L increases (or decreases) if θ increases (or decreases).

21 Services include restaurants and hotels, commercial household services, noncommercial household services, and private education.

22 According to Rodríguez and Tello (2009), the urban informal sector is responsible for about 82% of total employment in these two sectors (services and manufacturing).

23 The activities of firms in this sector include distribution, generation, and transmission of electricity.

24 In the formal water sector, investment also decreased from an average of US$250 million between 1998 and 2001 to US$130 million between 2002 and 2007 (Superintendencia Nacional de Servicios de Saneamiento, 2009).

25 These rates are exponential rates of growth.

26 Broadly speaking, the informal sector comprises small-scale, semilegal, often low-productivity, frequently family-based, perhaps precapitalistic enterprises that continue to employ between 30% and 70% of the urban workforce in Latin America (Maloney, 2003; Maloney et al., 2007).

27 Excluding the traditional agricultural sector because the contribution of agriculture as a whole (i.e., the modern and traditional sectors) was positive in the recession period of 1997 to 2001. Taking the difference between average and marginal labor productivity into account, the contribution of the agricultural sector is negative and of the same size as the negative rate of growth of labor productivity for the Peruvian economy.

28 Manufacturing branches in the tables include Dairy Products to the Rest of Manufactures.

29 Between 2002 and 2007, for a sample of 297 small (fewer than 21 workers) formal firms, the rate of growth of labor productivity declined to -4.9%.

30 Guidelines of such reforms are available (Barcelona Development Agenda, 2004; Serra & Stiglitz, 2008; World Bank, 2005).

31 These sectors boast a large share of the total employment in the Peruvian economy and reflect low labor productivity and real wages; most people occupied in these sectors live in poverty.

32 Maloney et al. (2007) provided examples of such reforms. In the overview of their book, the authors postulated the following: *"Achieving significant reductions in present informality levels will require, first and foremost, actions to increase the aggregate productivity in the economy. A more enabling investment climate will permit formal firms to*

expand and pay higher wages. Raising human capital levels, especially for the poor, will permit more workers to find remunerative jobs in a more dynamic formal sector. Without such improvements in aggregate productivity, we will continue to find a very large number of micro-firms, characterized by high turnover, weak growth prospects, and low productivity, that would see little benefit in engaging with formal institutions." (p. 13).

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