Factor payment shares in a large cross-section of countries

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1 Introduction

The division of national income into factor payment shares is arguably the simplest, most meaningful, and most elusive way to summarize a national economy. This paper examines the division into payment shares of labor, produced capital, and natural capital for a group of 81 countries at diverse levels of economic development in the year 2005. The division is elusive because, as Gollin (2002) has established, the labor share based on raw national accounts data for compensation of employees is unusually low for many developing countries; Gollin argues this is because gross operating surplus conceals payments to labor within unincorporated business income, reflected in high rates of self-employment in these countries. The division is rendered even more opaque by Caselli and Feyrer (2007)'s findings that the share accorded to non-labor income hides significant payments to natural resources, especially among low income countries for which the World Bank has documented large stocks of land-based natural wealth. This paper draws heavily on these earlier studies, but tackles the measurement problem from a different angle. Rather than basing payment shares on aggregate corrections from economy-wide measures of self-employment and resource stocks, I build payments shares from the ground up, using sector based measures of self-employment and sector based resource rents.

The difference in the two approaches, aggregate and sector based, stems in part from the significant difference in the size of the agriculture sector among countries at different stages of economic development. In low and middle income countries, the self-employed are concentrated in agriculture where wages are well below national averages. When economy-wide wage estimates ignore this concentration, the inferred labor payment share can easily exceed one. I also argue that imputing land rents from value added payments in agriculture addresses a significant bias in the natural capital share based on the World Bank's measure of resource stocks capitalized at a common discount rate for all countries. I eliminate this bias and consequently show that many low and middle income countries have significantly higher returns to capital than the United States. This result draws into question the widely cited findings of Caselli and Feyrer, who find the return to capital in most poor countries below that in rich countries.

The sector based measures also substantiate the large variation in wages across countries even for workers of the same skill level documented by Ashenfelter (2012) for McDonald's restaurant workers. The puzzle inherent in Ashenfelter's data, that McDonald's can replicate its efficient technology throughout the world and yet pay vastly different wages, is explained in part by my findings that the payment share to labor is in fact lower in many developing countries than in rich countries. This in turn supports a constant-elasticity-of-substitution (CES) production function specification that attributes variation in factor payments not only to differences in output per worker but also to the degree of substitutability between capital and labor.

Lucas (1990) illustrated his famous inquiry, "Why doesn't capital flow from rich countries to poor countries?", by comparing India's marginal product of capital to the United States'. In subsequent detailed studies of factor payment shares, India, along with China and Brazil and others are excluded due to the lack of data on self-employment or unincorporated business income. However, the strong negative correlation between rates of self-employment and the level of economic development is well-established and grounded in structural features such as the share of labor force in agriculture and the level of GDP per worker.[1] Using estimates of self-employment based on these stable patterns, I increase my sample by 30 countries, thereby estimating factor payment shares for a larger and more representative cross-section of countries that includes India, China, and Brazil.

The rest of the paper is organized as follows. After a brief literature review, I present the sector based data used here and compare the magnitude of differences in various estimates of wages and resource rents. Next, I compute factor payments shares and show how the two approaches result in significant differences in estimates of the return to capital and wages across countries. I then estimate an equation derived from the CES production function in terms of factor payment shares, confirming that the sector based factor payments shares are consistent with an elasticity of substitution between capital and labor in the range of 0.8. This section is followed by a brief summary and conclusions.

[1] This is of course the premise of Gollin's 2002 study. He explores the causes of self-employment in greater depth in Gollin (2008).

2 Literature review

Gollin (2002)'s careful and detailed study of labor's payment share set a high bar for subsequent cross-sectional comparisons. Bernanke and Gurkaynak (2001) is one of the few studies that uses labor payment shares adjusted for self-employment to account for unincorporated business income as advocated by Gollin. Caselli and Feyrer (2007) start with payment shares from Bernanke and Gurkaynak even though, as Bernanke and Gurkaynak note, some low income countries had to be dropped from their sample due to unreasonable results. In view of the complexities of sorting out payments to labor in unincorporated business income, and because Gollin found no strong correlation between labor's share and income per capita, many cross-sectional studies (e.g., Ferreira, Pessoa, and Veloso 2008) have continued to assume that labor's payment share is constant and close to that in the United States. However, in a detailed study of 27 OECD countries in the year 2000, Xiang (2008) uses sector based measures of wages and labor's share of corporate income to show that labor's payment share increases with income per capita, in contrast to Gollin's findings.[2]

Abu-Qarn and Abu-Bader (2009) estimate the payment share of physical capital using panel data and econometric analysis for 23 OECD countries, finding that it typically exceeds 0.5 in contrast to the 1/3 usually assumed in the literature; they show the implications of this difference for the measurement of total factor productivity growth. Based on Gollin's and Bernanke and Gurkaynak's payment shares, Aiyar and Dalgaard (2009) compare estimates of total factor productivity derived from a Cobb-Douglas and CES production function. They demonstrate that capital per worker, not output per worker, is the correct explanatory variable for differences in payment shares. Zuleta (2012) also presents alternative ways to measure total factor productivity that do not depend on constant factor payment shares across countries.

In view of data limitations and the large adjustments to raw value added data, country specific studies, especially of low income countries, are an important complement to cross-sectional studies. By looking at the evolution of factor payment shares and resulting computations of factor prices, country studies can control for data limitations and discern trends over time. Two excellent ex-

[2] In my study of international differences in factor-specific productivity, Marshall (2012), I correct value added payments from 33 OECD input-output tables in the year 2000 for self-employment by sector, but I do not examine why the resulting measures differ from the aggregate corrections.

amples of this approach are Poterba (1998) for the United States and Bai, Hsieh, and Qian (2006) for China. Focusing on the return to capital in China, Bai et al. show that the capital payment share in China is around 50 percent (between 1978 to 2005) while Poterba finds that the capital share in the United States (between 1959 to 1996) is between 20 to 30 percent, depending on how proprietors' income is adjusted.

Many studies refer to Caselli and Feyrer's provocative finding that returns to capital are lower in poor countries than rich countries once the relative price of capital goods and the share of natural resource rents are taken into account (Papaioannou 2009; Chatterjee and Naknoi 2010; among others). The paucity of data on natural resource revenues has so far limited alternative approaches to breaking down payments to non-labor income. Taken together, these recent cross-section studies and case studies confirm that differences between countries are non-trivial and that accurate factor payment shares for labor, physical capital, and natural capital can be used to analyze such fundamental economic features as total factor productivity, factor payments, and the appropriate aggregate production function. The heavy reliance of subsequent literature on what I refer to as aggregate measures presented in Gollin and Bernanke and Gurkaynak justifies this paper's effort to reexamine and hopefully to improve upon their procedures.

3 Factor payment shares and value added data

The United Nation's Statistical Division publishes detailed official national accounts data used in this study, as well as by Gollin (2002) and Bernanke and Gurkaynak (2001). Value added data is reported in three main components: gross operating surplus (GOS), compensation of employees (COE), and indirect taxes. COE is defined as the total remuneration payable by an enterprise to an employee in return for work, and GOS "measures the surplus or deficit accruing from production before taking account of any interest, rent or similar charges payable on financial or tangible non-produced assets borrowed or rented by the enterprise..."[3] Mixed income is the special name given

[3]Quoted from the United Nations Statistical Division glossary for the term "operating surplus" at http://data.un.org.

to operating surplus earned by unincorporated households, or the self-employed.[4] Apart from Xiang (2008) and Marshall (2012), earlier estimates of payment shares start with value added data aggregated for the entire economy, but many countries report the same value-added breakdown for the 16 broad sectors in the International Standard Industrial Classification (ISIC) Rev. 3 typology. Since the level of detail for sectors varies somewhat between countries, I have combined the raw sector data into the 9 sectors delineated in the headings of Table 1 for 81 countries in the year 2005.[5] The International Labor Office publishes self-employment by ISIC sector for 64 countries around the year 2005; the overlap between these two main data sources is 51 countries.[6] This data on self-employment and value added by sector allows me to examine in depth how aggregate corrections for self-employment differ from sector based corrections, and to construct a different measure for resource rents compared to that presented in Caselli and Feyrer.

Gollin (2002) emphasizes the importance of mixed income for low income countries where a large share of the labor force is self-employed and, since few countries report mixed income, examines alternative ways to measure labor payments to the self-employed. Based on Gollin's study, Bernanke and Gurkaynak (2001) adjust labor payments in a given country by estimating the average wage $\tilde{w} = {}^{COE}/_{E}$ where E is the number of employees, and then measuring payments to labor by $\tilde{w}L$, where $L = E + S$ and S represents the number of self-employed workers.[7] The accuracy of this aggregate correction for self-employed labor earnings depends on two distinct simplifying assumptions: first, that wages are about the same between the two groups of workers, employees and the self-employed, and, second, if wages vary significantly between economic sectors, that the distribution of self-employed workers across sectors is fairly uniform. Bernanke and Gurkaynak

[4] In the past, mixed income was labeled operating surplus, private unincorporated enterprises (OSPUE).

[5] Five countries, Brazil, China, Indonesia, Japan, and Taiwan, reported incomplete data in the United Nations source but have detailed OECD input-output tables available for 2005, or in the case of Taiwan, 2006. For these countries, I aggregated the more detailed input-output tables to the same 9 sectors.

[6] In the International Classification by Status in Employment revised in 1993 (ICSE-1993) there are 6 groups of workers, the first of which is employees. I define self-employed as the total number of workers in all groups minus the number of employees.

[7] They actually use two alternative measures in addition to the wage measure but the other two methods are also based on aggregate corrections, using actual mixed income or imputed mixed income for the economy as a whole. Comparing the 37 countries for which they compute the wage method and at least one other method, for 30 of those countries the different labor payment shares are within a plus or minus margin of 5 percent of each other. The largest difference in the three methods for any country was Japan, whose labor share based on actual mixed income was 0.68, about 12 percent below the labor share of 0.77 computed with the wage method.

observe that the calculated labor shares often exceed one for countries with a high share of self-employed workers, attributing this unreasonable result to poor economic statistics. Another possible explanation is that the simplifying assumptions of the aggregate measure are invalid.

I first consider the possibility that wages vary across sectors but are the same for both groups, employees and the self-employed, within the same sector. Let the subscript i index n sectors, so that total employment in each sector is given by $L_i = E_i + S_i$, the rate of self-employment in a given sector is $s_i = {}^{S_i}/_{L_i}$, and the aggregate share of self-employed is denoted by $s = {}^{S}/_{L}$. In this case, the correct wage in each sector is given by $w_i = {}^{COE_i}/_{E_i}$ but error is introduced through the weight given to each sector's wage. The economy-wide average wage w as a function of the wage in each sector w_i is given by

$$w = \sum_{i=1}^{n} w_i \frac{L_i}{L}.$$

The aggregate approximation of this wage can be re-written as

$$\tilde{w} = \sum_{i=1}^{n} w_i \frac{E_i}{E} = \sum_{i=1}^{n} w_i \frac{(1-s_i)L_i}{(1-s)L} \tag{1}$$

To the extent that the self-employed are concentrated in low-wage sectors, the weight will be too low on those sectors, causing $\tilde{w}$ to overestimate the average wage and hence labor's payment share. Table 1 summarizes the distribution of self-employment shares across sectors for 64 countries categorized by income group, and also notes the importance of each sector in total employment. Self-employment in the agriculture sector is substantial for countries in all income groups, but for high income countries whose share of total agriculture employment averages only 5 percent, this high self-employment share likely has little bearing on the weighted average computed in Eq. 1. For all other countries, given the combination of high self-employment and a high share of total employment in agriculture, a lower wage in this sector could result in a large difference between $\tilde{w}$ and w. Among upper and lower middle income countries, the trade sector also has both a high rate of self-employment and a significant share of total employment.[8]

[8]Agriculture, representing ISIC sectors A and B, includes forestry and fishing; trade is short-hand for ISIC sectors

The question thus becomes whether wages in these two sectors, agriculture and trade, are significantly different from the economy-wide average. Table 2 presents data on wages by sector compared to the average economy-wide wage in the smaller group of 51 countries for which self-employment and value-added data by sector is available. In each country, the wage ratio in each sector is estimated by $\frac{COE_i}{E_i}/\frac{COE}{E}$. Among the high income countries, there is little variation in wages between sectors, but for all other countries, workers in the agriculture and trade sectors earn below-average wages. The overall picture among middle and low income countries is still complicated by the substantially higher wages in other sectors. An exact depiction of the difference between $\tilde{w}$ and w is given in Fig. 1. Due to the concentration of the self-employed in low wage sectors, the employee based wage estimate is at least 10 percent higher than the true economy-wide average wage for 14 of the 30 countries with real GDP per worker below $50,000, and exceeds 20 percent for 7 of these countries.

The assumption that wages are the same on average for employees and self-employed in a given sector is more difficult to address with the available data. There are two possibilities. First, if the self-employed earn more on average than employees in a given sector, labor's share of income in that sector will be underestimated by the sector based measure. For example, if self-employed farmers earn more than farm workers, the self-employment correction in the agriculture sector will result in an underestimate of labor payments, a serious error for low income countries with a large share of value added in agriculture. Second, if the self-employed earn less than employees, it is possible for the estimate of labor share's to exceed one in a given sector, since the sector-specific wage is always estimated by ${}^{COE_i}/{}_{E_i}$. In fact, the data suggest that it is the second problem that arises in the agriculture sector, since the total labor share often exceeds one when the self-employed are assumed to earn the same wage as employees. I return to this point below when I discuss in greater detail the division of factor income in the agricultural sector.

G and H which include wholesale and retail trade, vehicle repairs, and hotel and restaurant services.

3.1 Estimating self-employment

Fig. 1 shows that the accurate measurement of labor payments depends not just on aggregate self-employment but also on the distribution of self-employment and total employment in different sectors, especially in agriculture. The International Labor Organization reports self-employment by sector for only 51 of the countries in my sample of 81 countries for which value added data by sector is available. However, the distribution of self-employment across sectors and the total amount of self-employment are tightly linked to overall employment in agriculture and to the level of economic development in a given country. The Food and Agriculture Organization of the United Nations (FAO) publishes data on employment in agriculture as a share of the total labor force for almost all countries in the world, and real GDP per worker is a readily available proxy for economic development. I am therefore able to estimate the amount of self-employment in three broad sectors, agriculture, mining, and all other non-natural resource sectors, as a function of basic economic indicators.[9] I use these estimates, reported in Table 3, in the remainder of this paper for those countries which do not report self-employment by sector, although I continue to use actual self-employment data for those 51 countries which do.

3.2 Factor payments in resource-intensive sectors

In the agriculture sector, payments recorded as GOS capture both labor payments to the self-employed and land rents, in addition to the return on produced capital employed in this sector.[10] Caselli and Feyrer (2007) emphasize the importance of land rents, particularly in low income countries, and adjust for this payment using the stock of land-based natural resources compiled by the World Bank. I divide GOS into payments to labor and capital, and make sure that the sum of all three value-added components (labor, produced capital, and natural capital) does not exceed the overall size of total value-added in agriculture sector. I also address a methodological problem

[9] I also estimate mining employment based on the compensation of employment share of mining from the value-added data.

[10] I assume that resource rents are recorded in the sector of origin. This is consistent with the widespread use of value added to measure the size of a given sector. Technically, it is possible that some land rents are recorded as payments to the real estate sector, but an examination of 41 OECD input-output tables shows that the real estate sector is a trivial intermediate input into agriculture.

inherent in the use of a stock of natural resources to determine the return to capital, given the manner in which the value of the stock is constructed.

For almost all countries in my sample, the share of GOS in agriculture value added is larger than the economy-wide share of GOS, an indication that it captures land rents and labor payments in addition to the return to produced capital.[11] However, there is strong evidence that the labor payment to the self-employed in agriculture, a group which in low income countries often accounts for the bulk of poverty, is overestimated by the standard wage-based correction of self-employment even at the sector level.[12] Table 2 shows that wage estimates based on COE in the agriculture sector are much lower than other sectors in most countries. If I assume that the self-employed in the agriculture sector, indicated by subscript 1, also earn the wage estimated by COE_1/E_1, the resulting total labor payments in agriculture exceed 60 percent of value-added in that sector for 48 countries in the sample, and exceed 100 percent for 22 of those countries.

I adopt a very simple solution to this problem: I cap the labor share of agriculture value-added at 60 percent for the 48 countries for which the wage-based self-employment adjustment exceeds this amount. Even after applying the cap, for all countries except China and Sri Lanka the resulting labor share in agriculture is still substantially higher than the unadjusted compensation of employees share.[13] The cap assures that all countries have value added payments in agriculture to account for payments to produced capital and land rents.

The World Bank has undertaken an ambitious and unique on-going effort to measure all assets, including natural resource stocks, produced capital, and intangible capital (institutional quality

[11] The median value of the ratio of unadjusted $GOS/(GOS + COE)$ in the agriculture sector, compared to the same measure economy-wide, is 1.3 for all 81 countries. For only 5 countries is this ratio below 1. China is most notable since economy-wide $GOS/(GOS + COE)$ is about 0.5 while in the agriculture sector it is only 0.09. Bai et al. (2006) note that China's National Bureau of Statistics count self-employment labor income as labor income, which may be reflected also in the OECD input-output table used for China in this study. It is not clear how China's statisticians deal with land rents.

[12] World Bank (2007), page 26, notes that "Three out of four poor people in developing countries - 883 million people - lived in rural areas in 2002."

[13] I confirm that the resulting implicit wage in agriculture compared to the economy-wide wage in each country is reasonable by comparing the two groups of countries, capped and non-capped. In the capped group, the average ratio of the agriculture wage to the economy-wide wage is 0.44 and the standard deviation is 0.32, while in the non-capped group of 33 countries the average ratio of the agriculture wage to the economy-wide wage is 0.47 and the standard deviation is 0.31. In both groups there are outliers on either extreme, with the most notable being China in the capped group, whose agriculture wage is only 6 percent of its economy-wide wage. In the non-capped group, Senegal and Niger fall in this same low range.

and human capital), for an extremely large group of countries. The most significant land-based asset is cropland, although the land-based resource stock also includes the value of forest, pasture, and protected areas. World Bank (2011), pages 148 to 149, describes in detail the procedure used to compute the stock of cropland, which I summarize here. First, they determine the production volume of various crops in a given country, and then the value of these crops using world prices, giving a base measure of revenue from crop production. They then assume a constant rental rate of 30 percent of total crop revenue to infer the amount of rental revenue. Next, they project the rental revenue forward over a 25 year time-horizon by assuming an annual growth rate in production, equal to 0.97 percent in developed countries and 1.97 percent in developing countries, and then compute the present value of this flow using a discount rate of 4 percent for all countries.

The World Bank procedure to estimate natural resource stocks is necessarily different from the standard estimate of the physical capital stock, known as the perpetual inventory method. The perpetual inventory method is grounded in the notion of produced capital accumulated as a stream of new investment subject to depreciation. The perpetual inventory method is the prevalent way to compute the value of produced capital, used for example both by Caselli and Feyrer and the World Bank in its computation of the produced capital component of total wealth. Since natural resources are not produced, there is no analogous way to compute their value.

The distinction between the two procedures becomes relevant when inferring the share of rents to produced capital in total rents from the share of the stock of produced capital in total produced and natural capital. The estimation of the natural resource stock implies a rate of return to land, assumed by the World Bank to be the same for all developing countries. Let R_N represent the land rental payment for a given country in a given year, and N represent the value of the stock of land in that year. The World Bank procedure is given by $N = \sum_{t=0}^{24} \frac{R_N(1.0197)^t}{(1.04)^t}$, which simplifies to $N = 19.93R_N$ and so implies that $\bar{r}_N = 0.05$ where $\bar{r}_N$ is the rental rate of land. Assume for now all natural wealth is land stocks. (I discuss mineral resources below.) Caselli and Feyrer determine rental payments to produced capital, R_K, by assuming that the return to both land and produced capital is the same, denoted by r. Define the stock of total wealth, W, as equal to the sum of produced capital, K, valued at its local price P_K, and natural capital: $W = P_K K + N$. They assume that

$$\frac{rP_KK}{rN + rP_kK} = \frac{R_K}{R_N + R_K} = \frac{P_KK}{N + P_KK} \tag{2}$$

Since they only observe the term on the far right-hand side of Eq. 2, derived from World Bank stocks, they use it to infer the produced capital payment share, α_K in total wealth payments, α_K/α_W. However, their measure based on the World Bank stock estimates is in fact

$$\frac{R_K}{r(R_N/\bar{r}_N) + R_K}.$$

For those countries where $r > \bar{r}_N$, Caselli and Feyrer (2007)'s measure of α_K/α_W will be biased downward, and the bias will increase with the share of land in total wealth. To eliminate this bias, either the stock of land should be based on land rents capitalized at the same rate r as produced capital, or the share of produced capital rents in total rents should be based on rental payment flows, not wealth stocks.

My own approach relies on estimating land rental payments R_N as a portion of GOS generated in the agriculture sector. I begin with the World Bank's initial assumption that rental payments to land are equal to 30 percent of revenue generated in the agriculture sector. Based on OECD input-output tables for 41 countries, the median share of unadjusted GOS in total agriculture revenue is about 40 percent. A rough estimate of land rent is therefore 75 percent of raw GOS. However, I have already reduced raw GOS to account for the self-employed labor payments in agriculture, so I increase my land rent estimate to 0.9 of adjusted GOS. This approximation reflects several realistic constraints: labor payments in agriculture must be higher that COE to account for the large number of self-employed, land rents cannot exceed the remaining value-added payments in agriculture, and some share of value-added payments represent payments to produced capital in agriculture.

I use the same procedure to estimate resource rents from mining sector GOS, after first adjusting GOS for self-employment in the mining sector. Although the self-employment labor adjustment to raw GOS in mining is relatively small due to a much lower rate of self-employment in this sector, the rental rate of mineral resources is generally higher than land. For example, Hamilton and Clemens (1999) estimate that 65 percent of the price of crude oil represents resource rents, and so I continue to assume that 0.9 of adjusted GOS represents resource rents in this sector. The World Bank estimates mineral resource stocks in the same manner as it estimates land-based resource stocks, using a discount rate of 4 percent over a 25 year time horizon, but accounting for depletion of the resource stock by assuming a constant rent payment. The implicit rental rate for mineral resources is thus given by $N = \sum_{t=0}^{24} \frac{R_N}{(1.04)^t}$ so that ${}^{R_N}/_{N} = 0.062$.

I have assumed that resource rents are recorded in the value added of the sector in which they are generated, and I have made a crude measure of the portion of value added, setting it equal to 0.9 of adjusted GOS in both agriculture and mining sectors for all countries. The World Bank measure of resource stocks is based on a detailed analysis of each country's production of each type of commodity, valued at world prices, and then converted to a stock by taking the present discounted value of the rental payment at the same discount rate for all countries. The World Bank measure is an inaccurate proxy for the share of resource rents in total payments to capital when the intent is to uncover the unobserved rate of return to capital, assumed to vary across countries. Nevertheless, if my own measure of resource rent is legitimate, it should be highly correlated with the World Bank stock measure even though the two measures use different procedures and data sources. For example, countries with a large stock of cropland in production should record a large amount of land rent in agriculture value added, and by assumption the World Bank stock measure is in fixed proportion to the rental flow measure across countries.

I test this proposition by regressing my resource rent measure on the World Bank stock measure.[14] I allow for differences in both the slope and intercept terms of the regression between two country groups, high income and all others. Table 4 presents the results of two regressions, one for land-based resources and one for mineral resources. The value added based land rents are about 2 percent of the land-based resource stock, a very tight estimate that does not vary between the

[14]The World Bank stock measures are reported in United States dollars, while national accounts data is reported in local currency units. I therefore relied on market exchange rates reported in the World Development Indicators for 2005 to convert national income data to United States dollars. After the conversion, four countries were extreme outliers, with rent values several times larger than World Bank stocks. However, all four countries, Mozambique, Sudan, Romania, and Venezuela, had undergone major currency reforms in 2005 or within a few years after. I attributed these outlying values to currency conversion problems and excluded them from the regressions.

different groups of countries. For high income countries, mineral rents are about 12 percent of the stock of mineral resources, although much lower for other countries. For both types of resources, the R^2 exceeds 0.8, which I interpret as affirming that my resource rents are valid estimates of resource earnings across diverse countries. In Fig. 2, I show the importance of the distinction between the share of rents and the share of stocks for both land based and mineral resources. The top panel of Fig. 2 confirms that this distinction matters most for countries with a large share of land-based natural resources. As shown in the bottom panel of Fig. 2, the difference between my measure of mineral rents shares and the World Bank stock measure is far less significant.

3.3 Factor payments in non-resource-intensive sectors

The self-employment share of the non-resource labor force is typically much lower than that in agriculture, and for middle and low income countries, is more concentrated in low wage sectors such as trade, as shown in Table 1 and Table 2. The degree of this self-employment wage discount can be computed by taking the weighted-average wage of the self-employed in the 7 non-resource sectors and comparing that to the average employee wage in these sectors, using the detailed data on self-employment and sector based value added for 51 countries in my sample. I then use an estimate of this average wage discount to adjust the self-employed wages in countries which do not report self-employment data. The results are depicted in Fig 3. The self-employment discount, d, is on the order of about 80 percent of the average wage in countries with GDP per worker around 10,000 PPP dollars.[15] Again I am unable to correct for differences in the earnings of the self-employed within a given sector, and the discount reflects only the distribution of the self-employed across sectors; for high income countries there is essentially no discount since wages are fairly uniform across sectors. Given this country specific discount, I estimate the labor payment in the non-resource sectors, indicated by subscript 3, in a given country by $(1-s_3)\tilde{w}_3L_3 + s_3d\tilde{w}_3L_3$. In the non-resource sector, all non-labor income is attributed to produced capital and urban land.

[15] The discount is estimated for countries that do not report self-employment data by a simple quadratic in GDP per worker for country c, y_c, as follows: $\hat{d}_c = 0.73 + 8.41 * 10^{-6} * y_c - 6.46 * 10^{-11} * y_c^2$. The t-statistics in order are: 8.96, 2.23, and -1.72 estimated with White heteroskedasticity-consistent standard errors, with $R^2 = .33$ and $N = 51$.

3.4 Payment Shares

Fig. 4 shows the final outcome of the two approaches to determining labor's share of factor payments, α_L, compared to the raw data.[16] The sector based adjustment can be viewed as the middle ground between the very low shares of COE in the raw data, and the unrealistically high shares of labor payments that result from the aggregate measure for low income countries. All those countries whose aggregate labor shares exceeds 1 are countries for which I estimated the aggregate self-employment shares; it is possible that the unreasonableness of these results reflects inaccurate estimates of self-employed. However, the structural features of self-employment for the economy as a whole in relation to GDP per worker, the share of the workforce in agriculture, and population are strong, as indicated in Table 3. There is no easy resolution to these data limitations, but I would argue that the sector based measure is the best way to address them short of throwing these major countries out of the sample. I also note that the sector based measure suffered from the same problem of excessive labor payments within the agriculture sector, which I addressed by capping the self-employment share at 0.6 to allow for land rent payments as well as labor and capital payments. In subsequent comparisons of the two measures I will therefore cap the aggregate labor share at 0.8 for those countries in which it exceeds this value.[17]

To summarize, the sector based payment share for labor is based on a weighted average wage by three broad sectors: 1) agriculture, 2) mining, and 3) all other non-resource sectors. In each of the sectors I have adjusted for self-employment, thereby taking into account that the share of self-employment and the average wage differ substantially across the three sectors. I have estimated the relevant self-employment shares for 30 countries, and in the third sector I also use an estimated discount of the wage of the self-employed in this sector for these countries. I estimate the resource share of factor payments, α_N, by setting resource rents equal to 0.9 of adjusted GOS in the first two sectors. The remaining adjusted GOS is allocated to produced capital and urban land, α_K. I also replicate the aggregate corrections, using aggregate self-employment and World Bank resource

[16]The denominator in the payment shares is always value added less indirect taxes, following the convention in the literature.

[17]This constraint affects 13 countries in total: Korea, China, Honduras, India, Indonesia, Italy, Kenya, Morocco, Mozambique, Niger, Senegal, Sri Lanka and Sudan. The labor share estimates for Korea, Honduras, Italy, Indonesia, and Morocco, which all fall between 0.8 and 1, are based on self-employment data, not estimated self-employment.

stocks now published for the year 2005, to show how significant the difference is between sector based and aggregate measures, where the latter also use World Bank resource stocks to estimate the produced capital share of rents. In the remainder of the paper I examine these differences by comparing the implied factor payments of each approach, and showing that only the sector based measures substantiate a CES production function.

4 Cross-country comparisons of the return to capital and labor

Given these estimates of factor payments shares, factor payments are inferred by multiplying the factor's payment share by total value added, and then dividing by the factor stock. This is one of the most valuable uses of factor payment shares, a use which underscores the importance of accurately measuring these shares. For example, Caselli and Feyrer's main intent in measuring the payment share of produced capital, α_K, is to then infer the rate of return to capital. Because they find uniformly low rates of return to capital among developing countries, they conclude that the reallocation of capital across countries will have little impact on global production. I show here that the sector based measure of capital's payment share, applied to the same price-adjusted measure of the capital output ratio used by Caselli and Feyrer, gives a very different picture of variations in the return to capital across countries.

The presence of large international differences in wages is presumably less controversial; for example, Ashenfelter (2012) confirms that there is a great deal of variation even for workers with the same skills and the same employer by comparing the wages of McDonald's employees throughout the world. The degree of these international differences in wages is of vital interest to promoters and detractors of globalization alike, so I also compare estimates of wages across countries implied by the two different computations of labor payment shares.

To make factor payments comparable across countries, I rely on PWT Ver. 6.3 data on real GDP measured in purchasing power parity (PPP) dollars, Y, and use PWT data to determine the stock of capital, K.[18] I apply Caselli and Feyrer's adjustment for the relative price of output to capital goods, P_Y/P_K, so that the rate of return to capital is given by

$$r = \alpha_K \frac{P_Y Y}{P_K K}$$

To make wages comparable across countries for the same education level, I adjust output per worker from PWT for human capital based on years of schooling to get output per unit of raw or unschooled labor, denoted by y_u.[19] The wage for unschooled labor is given by

$$w_u = \alpha_L (y_u)$$

The results of these computations for the return to capital are presented in Fig 5 and summarized in Table 5. Both approaches produce close to the same return for the United States, equal to 13 percent for the sector based measure and 12 percent for the aggregate measure. The sector based measure increases the variability of the return to capital for all income levels, especially low income countries. While the variation is greater, the return to capital on average for low income countries at 16.6 percent is substantially higher than that for high income countries, at 12 percent. However, this partly reflects the very high r computed for Nigeria, so I also show the average for low income countries without Nigeria, which is only 13.2 percent. Among the 50 middle and low income countries, there are 16 countries whose return to capital exceeds 15 percent. By comparison, the aggregate measure shows a sharp downward trend in the return to capital as income falls, similar to results presented in Caselli and Feyrer.[20] Within the group of 47 middle and low income countries

[18] I estimate capital following the procedure given in Caselli and Feyrer, but to compare my measure of the return to capital to theirs I also have to add urban land back into their measure of α_K since I am unable to remove it from mine. I describe the details in the Data Appendix.

[19] Using years of schooling from the Barro-Lee Educational Attainment Dataset Ver. 1.2, I convert years of eduction to human capital adjusted labor input based on the earnings gain per year of education, following Weil (2009), page 166. Specifically, the first four years of education increase wages by 13.4 percent per year, the next four years by 10.1 percent per year, and all additional years increase wages by 6.8 percent per year. Hence a worker in the United States, where average years of schooling is about 13, is equivalent to 3 units of labor input, while a worker in India, where average years of schooling is about 5, is equivalent to 1.8 units of labor input. The number of workers in this exercise is equal to the number implied by the PWT measure output per worker, denoted in that source as "rgdpwok".

[20] The values given in the Caselli and Feyrer (2007) study are not directly comparable since they are for the year 1996 and for a different group of countries, but are broadly in line with the results here. In their Table III, the return to capital in rich countries averages 8.4 percent with a standard deviation 1.9 percent, and for poor countries

estimated with the aggregate approach, only 2 countries have a return to capital greater than 15 percent; for most the return is substantially below that of the United States. [21] The difference between the two measures is clearly greatest for middle and low income countries where I have argued the distortions from applying aggregate corrections for self-employment and resource stocks is the greatest.

The two versions of labor payment shares also lead to different implications about international variations in wages, although the differences between the two measures are not obvious when comparing the average level of wages across income groups, as in Table 5. Indeed both measures confirm the presence of large differences in wages even after adjusting for different levels of education across countries, with workers in middle income countries earning a base wage of about half that of workers in high income countries, and workers in low income countries earning about a sixth that of workers in high income countries. To focus on the difference between the two measures, Fig. 6 presents the ratio of the aggregate based measure of w_u to the sector based measure. Here again it is apparent that the distortion increases at lower income levels: Among the 47 countries with GDP per worker below 30,000 PPP dollars, the aggregate estimate is 20 percent or more higher than the sector based wage estimate for 21 countries. Overall, the sector based measure substantiates lower wages but higher returns to capital as income falls, but also indicates a degree of variability between countries at the same income level.

5 Explaining differences in factor payment shares

As a first approximation, economists often explain differences in factor payments across countries by differences in capital per worker and total factor productivity (TFP) depicted in an aggregate production function. The most popular production function is the Cobb-Douglas (CD), both because its assumption of constant factor payments shares makes it highly tractable, and because constant factor payment shares have been a stylized feature of the U.S. economy over the second

averages 6.9 percent with a standard deviation of 3.7 percent.

[21] Three middle and low income countries, Cuba, Kazakhstan, and Paraguay, are dropped from the aggregate measure due to lack of World Bank data on their resource stocks.

half of the last century. The CES production function is a contending framework also considered by numerous studies, most notably by Duffy and Papageorgiou (2000) and Aiyar and Dalgaard (2009), whose results are discussed below. The crucial distinction between these two aggregate production functions is the degree of substitutability between capital and labor, which in turn determines the factor payment shares. I therefore examine the factor payment shares derived in this paper using the CES production function to establish whether or not the variations in payment shares I find can be explained by the degree of substitutability between capital and labor.

One of the major contributions of Caselli and Feyrer's study is to document the importance of natural capital in the total wealth stock of many developing countries, a component typically neglected in the empirical specification of physical capital within an aggregate production function. For the sector based measure of payment shares, I determine the stock of natural capital by assuming that the marginal product of produced capital is equal to the marginal product of natural capital, that is, that $\alpha_K(^Y/_K) = \alpha_N(^Y/_N)$ so that $N = (^{\alpha_N}/_{\alpha_K})K$. This amounts to capitalizing the stock of natural capital at the same return as that determined for produced capital in each country. As a robustness check, and to evaluate the aggregate measure of factor payments shares, I use the World Bank measure of the capital stock $K + N$.[22]

I combine physical and and natural capital together in a single measure of capital that is mixed with human capital to produce output. Assuming constant returns to scale, the standard CES production function explains output Y as a function of produced and natural capital $K + N$ and human capital hL by

$$Y = A[\delta(K+N)^{-\rho} + (1-\delta)(hL)^{-\rho}]^{-1/\rho} \tag{3}$$

where A measures Hicks-neutral total factor productivity, δ is the distribution parameter, and ρ determines the substitutability between capital and labor, $\sigma = {}^1/_{1+\rho}$.[23] Labor is measured in person years, and as noted above, h is based on years of education. I assume that the factors earn

[22] In the regression specifications I increase the PWT measure of the produced capital stock by 24 percent to account for urban land. Details of these adjustments are given in the appendix.

[23] Aiyar and Dalgaard (2009) examine the implications of Harrod-neutral technology, which has desirable traits for growth models. I leave alternate technology specifications combined with data used in this study for future research.

their marginal products, so that the ratio of the marginal product of human capital to physical and natural capital is equal to the ratio of the payment per unit to labor, $\alpha_L(^Y/_{hL})$ to the payment per unit of total capital, $\alpha_W(^Y/_{K+N})$. After simplifying and taking the natural logarithm of both sides of this ratio, I arrive at the following model to be estimated:

$$ln(l_c) = ln(\frac{(1-\delta)}{\delta}) + \rho * ln(k_c) + \epsilon_c \tag{4}$$

where l_c represents country c's value of $^{\alpha_L}/_{\alpha_W}$, and k_c represents country c's value of $^{(K+N)}/_{hL}$. The Cobb-Douglas production function is a special case of Eq. 4 where l_c is a constant value.

The CES specification in Eq. 4 allows me to estimate the parameters of the production function without identifying the level of A for each country, a distinct advantage for cross-section data. Duffy and Papageorgiou (2000) use a panel data set and non-linear estimation techniques to capture the parameters ρ and δ in the CES form given by Eq. 3. The challenge is to identify the level and growth of A, which in their initial specification is constrained to be the same for all countries.[24] The vast literature on development accounting, exemplified by Hall and Jones (1999), has long established that there are significant differences in the level of A by country. However, this literature typically assumes a Cobb-Douglas production function to solve for the level of A for each country.

Before presenting the results of the regressions, it is instructive to look at the regression data depicted in Fig. 7 in logarithm form to compare the two ways of measuring payment shares in relation to the respective measure of the total capital stock per worker, k_c. In the top panel, I show the sector based measure as a function of the imputed stock of total capital per worker, and in the bottom panel I show the aggregate based measure as a function of the World Bank measure of total capital per worker. Several observations are in order. In both panels there is a small group of outliers with a very low measure of l_c. These are four oil-rich countries whose mining sector GOS exceeds 30 percent of total value added, the highest in the total sample. At the other extreme, in the top panel are three low income countries, Kenya, Honduras, and Sri Lanka, whose values of l_c are extremely high compared to the bulk of the sample. In the bottom panel, the aggregate

[24] They then examine the evidence for different growth rates of A between groups of countries and different time periods by a linearized version of Eq. 3.

measure blurs the distinction between these three countries and the other 10 countries whose labor share was also fixed at 0.8.

After controlling for the small group of four oil-rich countries that have a significantly higher δ than the rest of the sample, the regression results presented in Table 6 establish that a CES production function gives a reasonably accurate depiction of sector based factor payment shares. Further precision is achieved by controlling for the group of three low income labor outliers, whose estimated δ is significantly lower than the rest of the sample. Controlling for both groups, the point estimate of $\rho = 0.2$ is highly significant, indicating that the elasticity of substitution σ is equal to 0.83. As shown by specification (4) compared to specification (3), this result is robust to the use of World Bank resource stocks rather than those imputed from value added measure of rents. Both measures confirm that natural resources are an important component of the capital stock often ignored in aggregate measures of capital.

The aggregate payment shares do not clarify much in the choice of production function. To control for labor outliers with the aggregate measure in specification (7), I included all 13 countries whose labor share of value added, α_L, was fixed at 0.8. For the aggregate measures, specification (7) gives the best results by the criteria of adjusted R^2, but shows that only the labor outliers and oil-rich outliers are statistically significant. In effect, the loss of information from the large number of labor outliers obscures the significance of the slope of the regression, ρ, whose estimate determines the elasticity of substitution.

Aiyar and Dalgaard (2009) also estimate several versions of Eq.4 using labor shares from both Gollin and Bernanke and Gurkaynak, together with produced capital per worker, but they do not obtain a statistically significant estimate of ρ. However, they consider a variety of ways to evaluate the data besides this simple function of factor payment shares and also conclude that the evidence supports a CES production function with an elasticity of substitution in the range of 0.8. I have shown here that the results from the simple specification in Eq.4 depend on accurate measures of factor payment shares and the capital stock. Regrettably, perhaps, such accuracy in turn depends on detailed constructions of labor and resource rent payments by sector.

6 Summary and Conclusions

Factor payment shares based on labor income and natural resource rents added up by sector argue for a wider range of factor payments across countries compared to those generated by aggregate simplifications. The difference between sector and aggregate measures is especially sharp for the return to capital, a key economic indicator used to assess the efficiency of the international allocation of capital. The results of this study support a growing body of evidence that the pattern of stable factor payment shares over time in the United States is not replicated in a wide cross section of countries. The simplest explanation for the observed cross country variation is that capital and labor are complements; in low and middle income countries, the absorption of labor is limited by capital requirements in modern industries. As capital becomes more abundant in high income countries, labor's share of total income increases. As a consequence, the return to capital is often higher in low and middle income countries and wages are often lower than would be predicted with a Cobb-Douglas production function.

In view of the wide range of returns to capital among countries in the same income group, this explanation may be only part of the story. For example, the monopoly power of owners of capital suggested by Parente and Prescott (2000) may contribute contribute to high returns to capital in some developing nations. The accurate measurement of factor payment shares is crucial to distinguish between a range of possible explanations for differences in factor payments. Such accuracy depends on accounting for structural features at the sector level that typify countries at different levels of economic development. In view of the large adjustments to raw data necessary to reflect the importance of self-employment and natural resource rents, cross-sectional studies should be complemented with country specific studies over time. Together these two approaches can determine the degree to which individual countries or groups of countries may diverge from a common pattern.

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Table 1: Self-employment as a percent of labor employed in each sector, with labor employed in each sector as percent of total labor in parenthesis

Income Group No. of countries	Agriculture A, B	Mining C	Man. D	Utilities E	Const. F	Trade G, H	Trans. I	Finance J, K	Other Services L, M, N, O, P	All Sectors
High	57	6	9	2	22	21	14	17	8	16
30	(5)	(1)	(18)	(1)	(8)	(19)	(7)	(12)	(29)	(100)
Upper Middle	62	10	18	2	26	39	28	17	11	30
16	(18)	(1)	(16)	(1)	(7)	(21)	(6)	(6)	(24)	(100)
Lower middle	72	24	24	3	32	56	37	21	16	50
12	(35)	(3)	(12)	(2)	(9)	(18)	(6)	(3)	(13)	(100)
Low	97	41	51	22	40	76	38	13	22	82
6	(70)	(0)	(5)	(0)	(3)	(9)	(3)	(1)	(9)	(100)

Source: International Labor Office Table 1.C. for 2005 or nearest year available.

Table 2: Ratio of wage in each sector to economy-wide average wage

Income Group No. of countries	Agriculture A, B	Mining C	Man. D	Utilities E	Const. F	Trade G, H	Trans. I	Finance J, K	Other Services L, M, N, O, P
High 28	0.64	1.16	0.94	1.40	0.99	0.92	1.09	1.45	1.04
Upper middle 13	0.58	1.99	0.94	1.65	1.06	0.85	1.42	1.64	1.07
Lower middle 9	0.42	2.68	1.11	2.25	0.70	0.83	1.36	2.04	1.30
Low 1	0.44	0.98	1.62	2.43	0.24	0.23	1.52	2.84	1.00

Source: Author's computations from value added and self-employment data.

Table 3: Estimates of the structural determinants of self-employment by sectors

	Agriculture	Mining	Non-resource	All sectors
Constant	-	1.027***	1.112***	1.137***
		(0.278)	(0.218)	(0.279)
Ln(real GDP per worker)	-	-0.117	-0.118***	-0.120***
		(0.021)	(0.017)	(0.024)
Ln(population)	0.057***	0.031**	0.034***	0.033***
	(0.003)	(0.015)	(0.011)	(0.008)
Agriculture labor force as percent of total labor force	0.005***	-	-	0.005***
	(0.001)			(0.001)
R^2	0.33	0.40	0.51	0.86
N	65	65	69	65

Dependent variable is self-employment as share of labor force in noted sectors.
White heteroskedasticity-consistent standard errors in parenthesis. ***, ** indicates significance at 0.01, .05 respectively.

Table 4: Value added resource rents regression

	Land	Mineral
Constant	0.212	4.175***
	(0.800)	(1.265)
High Income Dummy, H	1.470	-4.710***
	(1.090)	(1.626)
World Bank resource stock, S	0.020***	0.012*
	(0.004)	(0.007)
Interaction term, H×S	0.003	0.106***
	(0.004)	(0.014)
R^2	0.86	0.82
N	71	67

White heteroskedasticity-consistent standard errors in parenthesis. ***, ** , * indicate significant at 0.01, .05, 0.1 respectively.

Table 5: Estimates of factor payments by income group

	Sector based r	Aggregate r	Sector based w_u	Aggregate w_u
High Income	12.0	10.1	11,927	12,166
31 countries	(3.6)	(2.1)	(3,875)	(3,848)
Middle Income	12.1	7.0	4,330	4,854
40 countries	(5.9)	(3.9)	(1,825)	(1,892)
Low Income	16.6	6.4	1,519	2,186
10 countries	(11.9)	(9.5)	(774)	(994)
Low Income	13.2	3.5	1,643	2,374
excluding Nigeria	(5.2)	(1.2)	(708)	(846)

Notes: The return to capital, r, is percent per year, and the wage for unschooled, w_u, is PPP dollars per person year. Standard deviations are in parenthesis. For aggregate measure of r, there are 28 high and 37 middle income countries.

Table 6: CES regression results for sector based and aggregate estimates of $ln(\alpha_L/\alpha_W)$

	Sector				Sector		Aggregate	
	(1)	(2)	(3)		(4)	(5)	(6)	(7)
Constant	-0.615	-1.126*	-1.868***	Constant	-1.696***	2.554***	1.488***	-0.164
	(0.873)	(0.645)	(0.493)		(0.521)	(0.767)	(0.600)	(0.420)
Oil-rich outliers	-	-1.795***	-1.776***	Oil-rich outliers	-1.898***	-	-1.838***	-1.853***
		(0.176)	(0.154)		(0.175)		(0.231)	(0.161)
Labor outliers	-	-	1.598***	Labor outliers[a]	1.626***	-	-	0.998***
			(0.123)		(0.125)			(0.070)
Imputed $ln(k_c)$	0.082	0.139**	0.205***	World Bank $ln(k_c)$	0.194***	-0.201***	-0.086	0.060
	(0.083)	(0.061)	(0.047)		(0.051)	(0.076)	(0.058)	(1.486)
Adj R^2	0.003	0.371	0.589		0.588	0.102	0.463	0.739
N	81	81	81		75	75	75	75
F-stat.	1.274	24.599	39.210		36.158	8.296	30.992	66.995
Prob (F. Stat.)	0.262	0.000	0.000		0.000	0.005	0.000	0.000

Notes: White heteroskedasticity-consistent standard errors in parenthesis. ***, ** , * indicate significance at 0.01, .05, 0.1 respectively. Oil-rich outliers is equal to 1 for Nigeria, Oman, Kuwait, and United Arab Republic, and 0 for all others. Labor outliers is equal to 1 for Kenya, Honduras, and Sri Lanka, and 0 for all others.

a. Labor outliers for the aggregate measure include 13 countries whose α_L was set to 0.8

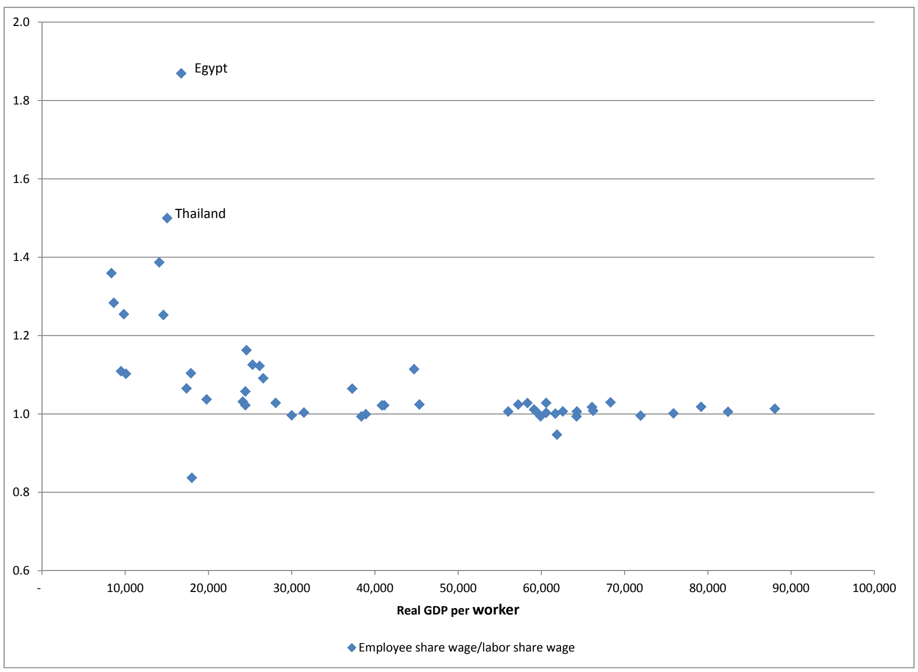
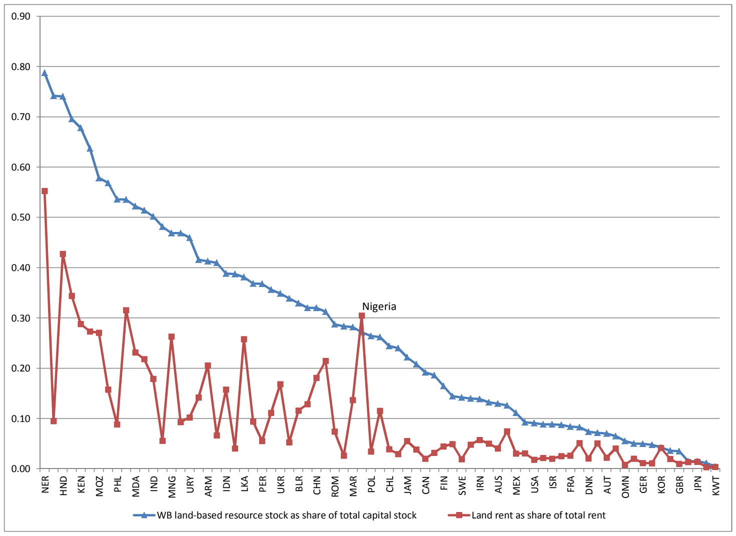
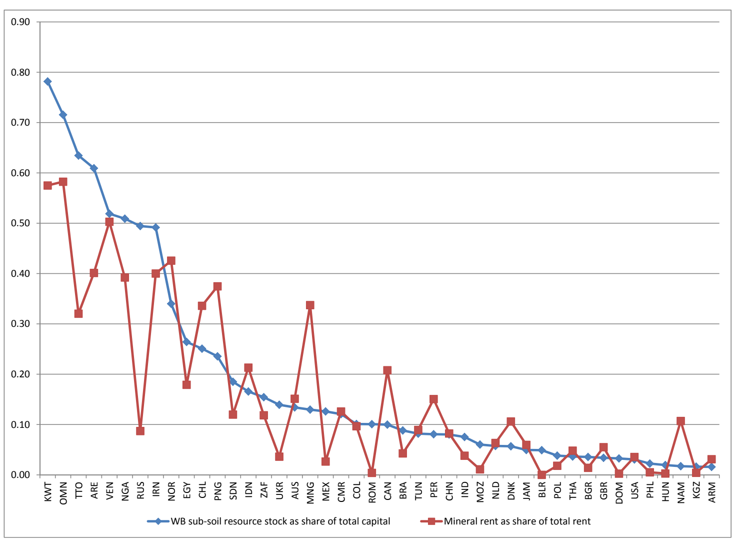


Figure 1: Ratio of employee based average wage, $\tilde{w}$, to labor share based average wage, w, for countries in Table 2



(A) Land resources



(B) Mineral resources

Figure 2: World Bank stock shares compared to rental shares equal to 0.9 of adjusted GOS in agriculture and mining sector. Note: Panel (B) includes only countries for which mining resource stocks equal or exceed 2 percent of total capital.

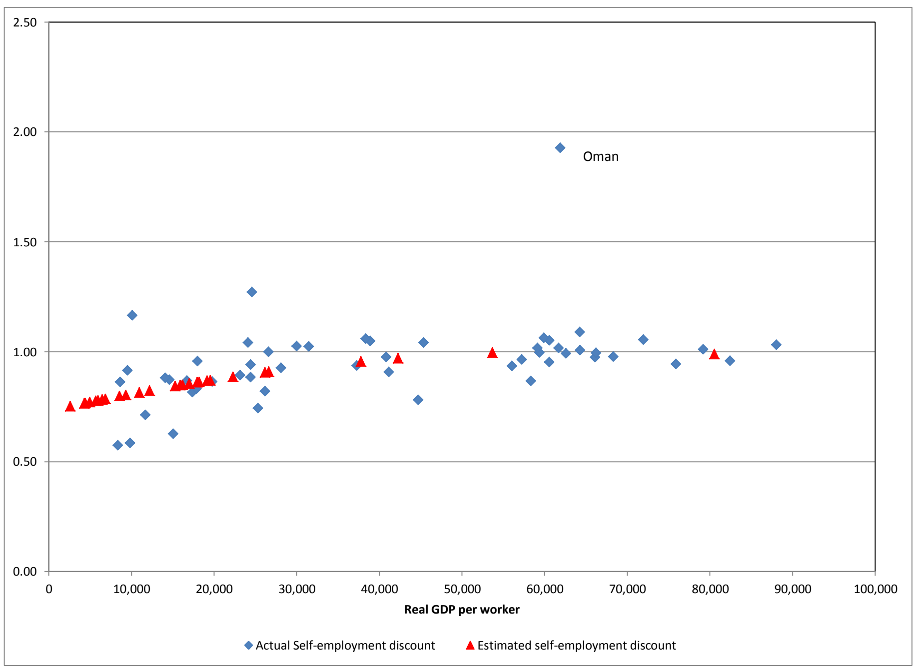


Figure 3: Wages of self-employed in non-resource sector relative to average wages in each country

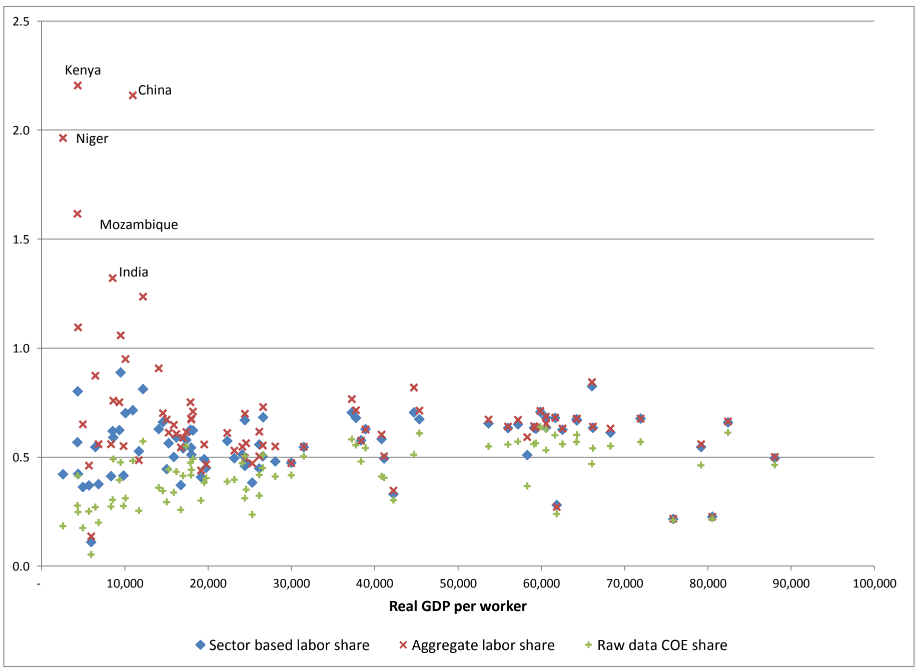


Figure 4: Labor shares adjusted for self-employment compared to raw labor shares

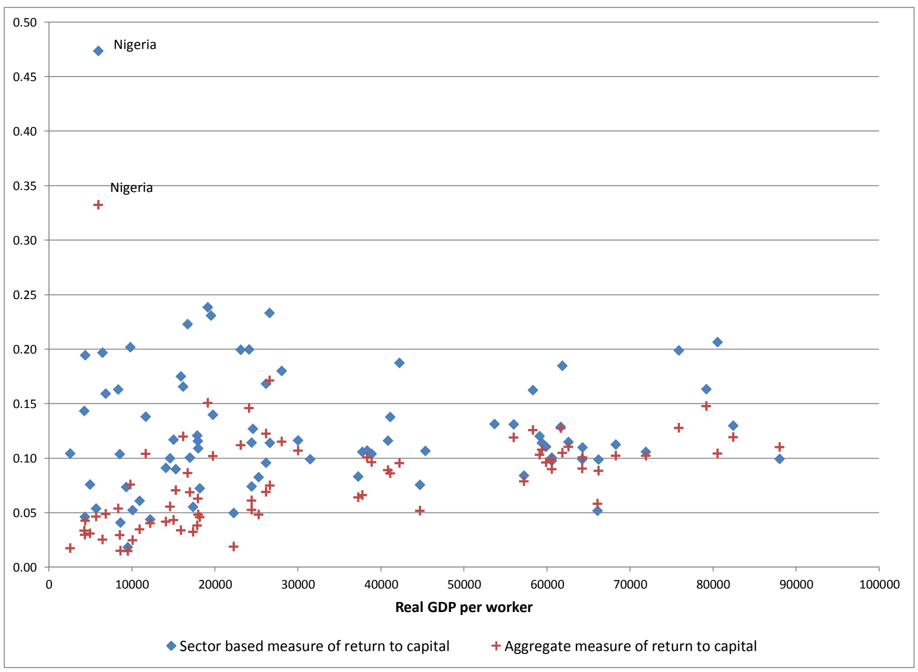


Figure 5: Aggregate and sector based return to capital

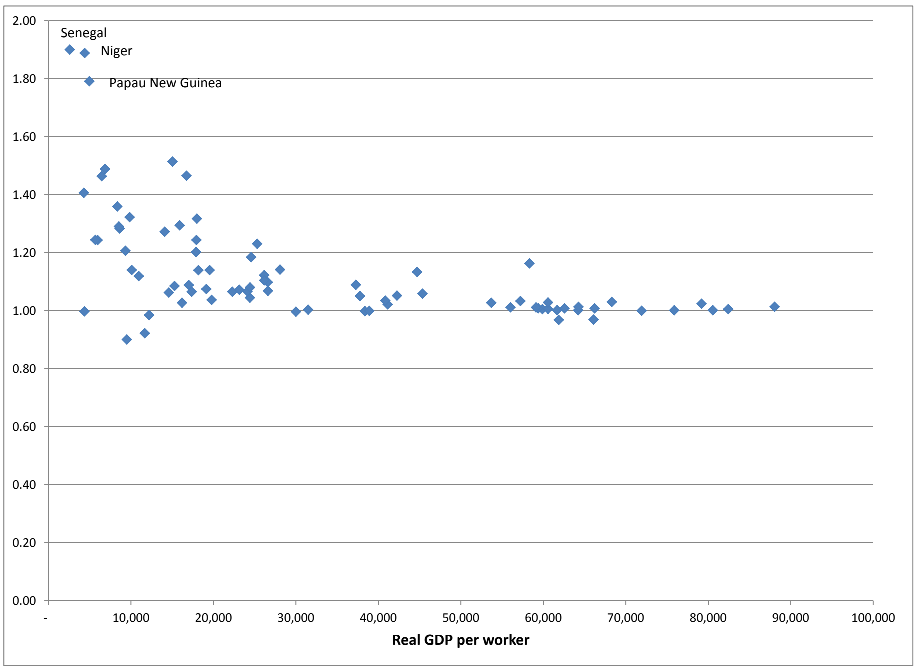
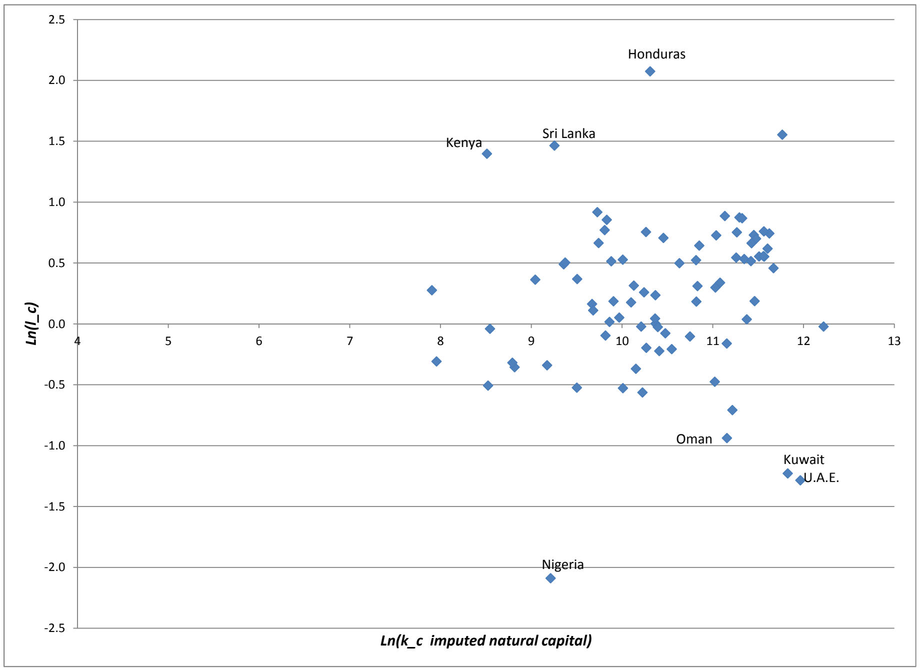
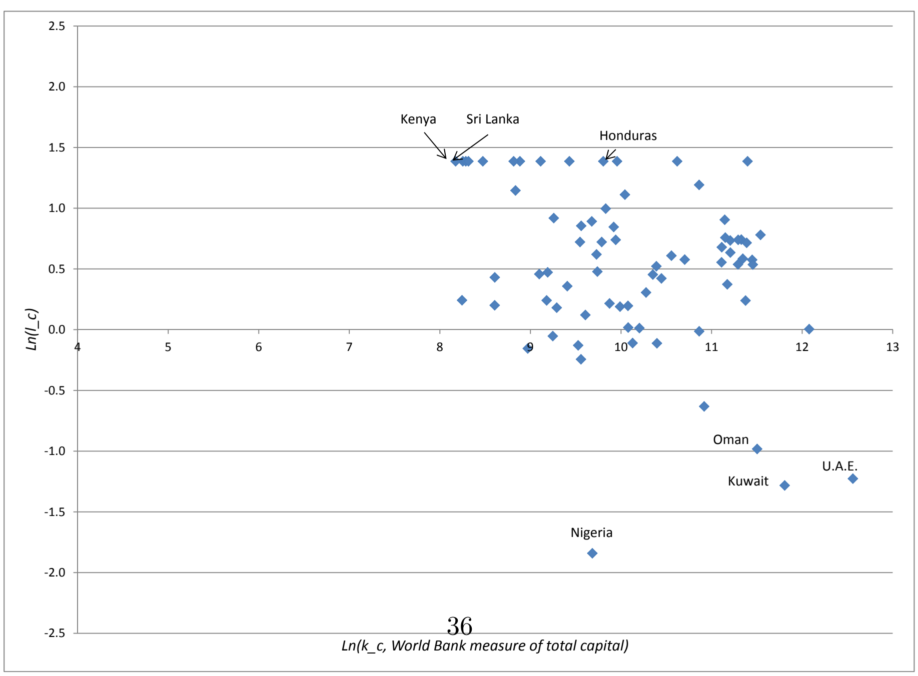


Figure 6: Ratio of aggregate wage estimate to sector based wage estimate



(A) Sector based l_c



(B) Aggregate l_c

Figure 7: CES regression data

Appendix

Following Caselli and Feyrer (2007), produced capital, K, is computed by the perpetual inventory method with a depreciation rate of 6 percent using PWT Ver. 6.3 data. The initial capital stock, K_0, is set equal to $I_0/(g + 0.06)$, where I_0 is the value of investment in 1950, and g is the growth of investment over the subsequent 20 years. My sample includes several Eastern European and former Soviet Union countries for which data do not go back to 1950, so I begin as early as possible and compute g for as many years as possible up to 20.

Caselli and Feyrer multiply their non-labor income share, α_w, by a ratio computed from World Bank stock measures to derive their payment share of produced capital, α_K. The World Bank accounts for urban land in its version of produced capital by augmenting produced capital for all countries by 24 percent. Caselli and Feyrer remove this component from the numerator of the ratio by dividing the World Bank's version of produced capital by 1.24, so the resulting ratio is produced capital only to total capital, where total capital includes produced capital, urban land, and natural resource stocks. I only subtract resource rents, not urban land rents, from my version of α_w to get my version of α_K so my payments to produced capital include payments to urban land. To make our two measures comparable, I increase the produced capital stock K estimated from PWT data by 24 percent, and I multiply Caselli and Feyrer's version (the aggregate version) of α_w by the World Bank's ratio of produced capital including urban land to total capital.

Four data tables follow. Table A presents the 81 countries in the value added sample, identifying the source of value added data and the source of self-employment adjustments. Table B presents the 69 countries for which self-employment data is available and the year of the ILO Table 1.C. Four of these countries only report urban self-employment so these countries were only used in the estimate of the self-employment discount for non-resource sectors. Table C reports the actual and estimated self-employment rates in three broad sectors: agriculture (s_1), mining (s_2), and non-resource sectors (s_3). Table C also reports the economy-wide self-employment rate (s) used in the aggregate measures, and the discount (d) used for self-employed wages in the non-resource sector. Table D presents the factor payment shares and payments computed using sector and aggregate measures. The World Bank does not compute resource stocks for 6 countries in the value added sample, so the aggregate measure of capital's share and the return to capital was not computed for these countries.

All data used in this study is available for free to download from various web sites, and the author would like to acknowledge and thank all those involved in this enormous effort to provide free and reliable data in electronic format. The following web page addresses for these various data sources are current as of this writing:

Barro-Lee Educational Attainment DataSet http://www.barrolee.com/
Center for International Comparisons at the University of Pennsylvania http://pwt.econ.upenn.edu/
The Changing Wealth of Nations http://data.worldbank.org/data-catalog/wealth-of-nations
International Labor Organization LaborSTA http://laborsta.ilo.org/
OECD Statistics http://stats.oecd.org/
United Nations Food and Agriculture Organization FAOSTAT http://faostat.fao.org/
United Nations Statistics Division National Accounts Official Country Data http://data.un.org/

Table A: Value-added by sector 2005 sample and source

Country Name	Income Group	Value-added source	self-emp. source
Armenia	Lower Middle Income	UN Table 2.3	estimated
Australia	High Income	UN Table 2.3	ILO Table 1 C
Austria	High Income	UN Table 2.3	ILO Table 1 C
Belarus	Upper Middle Income	UN Table 2.3	estimated
Belgium	High Income	UN Table 2.3	ILO Table 1 C
Brazil	Upper Middle Income	O.E.C.D.	ILO Table 1 C
Bulgaria	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Cameroon	Low Income	UN Table 2.3	estimated
Canada	High Income	UN Table 2.3	ILO Table 1 C
Chile	Upper Middle Income	UN Table 2.3	ILO Table 1 C
China	Lower Middle Income	O.E.C.D.	estimated
Colombia	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Costa Rica	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Cuba	Upper Middle Income	UN Table 2.3	estimated
Czech Republic	High Income	UN Table 2.3	ILO Table 1 C
Denmark	High Income	UN Table 2.3	ILO Table 1 C
Dominican Republic	Lower Middle Income	UN Table 2.3	estimated
Egypt	Lower Middle Income	UN Table 2.3	ILO Table 1 C
Estonia	High Income	UN Table 2.3	ILO Table 1 C
Finland	High Income	UN Table 2.3	ILO Table 1 C
France	High Income	UN Table 2.3	ILO Table 1 C
Germany	High Income	UN Table 2.3	ILO Table 1 C
Greece	High Income	UN Table 2.3	ILO Table 1 C
Guatemala	Lower Middle Income	UN Table 2.3	estimated
Honduras	Lower Middle Income	UN Table 2.3	ILO Table 1 C
Hungary	High Income	UN Table 2.3	ILO Table 1 C
India	Low Income	UN Table 2.3	estimated
Indonesia	Lower Middle Income	O.E.C.D.	ILO Table 1 C
Iran	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Ireland	High Income	UN Table 2.3	ILO Table 1 C
Israel	High Income	UN Table 2.3	ILO Table 1 C
Italy	High Income	UN Table 2.3	ILO Table 1 C
Jamaica	Upper Middle Income	UN Table 2.3	estimated
Japan	High Income	O.E.C.D.	ILO Table 1 C
Jordan	Lower Middle Income	UN Table 2.3	estimated
Kazakhstan	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Kenya	Low Income	UN Table 2.3	estimated
Korea, Republic of	High Income	UN Table 2.3	ILO Table 1 C
Kuwait	High Income	UN Table 2.3	estimated
Kyrgyzstan	Low Income	UN Table 2.3	ILO Table 1 C
Latvia	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Lithuania	Upper Middle Income	UN Table 2.3	estimated

Table A Value-added by sector sample – continued from previous page

Country Name	Income Group	Value-added source	self-emp. source
Macedonia	Upper Middle Income	UN Table 2.3	estimated
Mauritius	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Mexico	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Moldova, Rep. of	Lower Middle Income	UN Table 2.3	estimated
Mongolia	Lower Middle Income	UN Table 2.3	estimated
Morocco	Lower Middle Income	UN Table 2.3	ILO Table 1 C
Mozambique	Low Income	UN Table 2.3	estimated
Namibia	Lower Middle Income	UN Table 2.3	estimated
Netherlands	High Income	UN Table 2.3	ILO Table 1 C
Niger	Low Income	UN Table 2.3	estimated
Nigeria	Low Income	UN Table 2.3	estimated
Norway	High Income	UN Table 2.3	ILO Table 1 C
Oman	High Income	UN Table 2.3	ILO Table 1 C
Papua New Guinea	Low Income	UN Table 2.3	estimated
Paraguay	Lower Middle Income	UN Table 2.3	estimated
Peru	Lower Middle Income	UN Table 2.3	ILO Table 1 C
Philippines	Lower Middle Income	UN Table 2.3	ILO Table 1 C
Poland	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Portugal	High Income	UN Table 2.3	ILO Table 1 C
Romania	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Russian Federation	Upper Middle Income	UN Table 2.3	estimated
Senegal	Low Income	UN Table 2.3	estimated
Slovakia	High Income	UN Table 2.3	ILO Table 1 C
Slovenia	High Income	UN Table 2.3	ILO Table 1 C
South Africa	Upper Middle Income	UN Table 2.3	estimated
Spain	High Income	UN Table 2.3	ILO Table 1 C
Sri Lanka	Lower Middle Income	UN Table 2.3	estimated
Sudan	Low Income	UN Table 2.3	estimated
Sweden	High Income	UN Table 2.3	ILO Table 1 C
Taiwan	High Income	O.E.C.D. 2006	estimated
Thailand	Lower Middle Income	UN Table 2.3	ILO Table 1 C
Trinidad and Tobago	High Income	UN Table 2.3	estimated
Tunisia	Upper Middle Income	UN Table 2.3	estimated
Ukraine	Lower Middle Income	UN Table 2.3	ILO Table 1 C
United Arab Emirates	High Income	UN Table 2.3	ILO Table 1 C
United Kingdom	High Income	UN Table 2.3	ILO Table 1 C
United States	High Income	UN Table 2.3	ILO Table 1 C
Uruguay	Upper Middle Income	UN Table 2.3	ILO Table 1 C
Venezuela	Upper Middle Income	UN Table 2.3	ILO Table 1 C

Table B: Self-employment data sample and sources

Country Name	ILO Table 1. C Year	VA sample
Argentina	2000 *	No
Australia	2005	Yes
Austria	2000	Yes
Bangladesh	2005	No
Belgium	2000	Yes
Bolivia	2000	No
Botswana	2001	No
Brazil	2004	Yes
Bulgaria	2005	Yes
Canada	2000	Yes
Chile	2004	Yes
Colombia	2002	Yes
Costa Rica	2005	Yes
Czech Republic	2000	Yes
Denmark	2000	Yes
Ecuador	2005 *	No
Egypt	2005	Yes
El Salvador	2002	No
Estonia	2005	Yes
Ethiopia	2005	No
Finland	2002	Yes
France	2005	Yes
Germany	2002	Yes
Greece	2002	Yes
Honduras	1998	Yes
Hungary	2004	Yes
Indonesia	2000	Yes
Iran	2005	Yes
Ireland	2005	Yes
Israel	2005	Yes
Italy	2005	Yes
Japan	2005	Yes
Kazakhstan	2004	Yes
Korea, Republic of	2000	Yes
Kyrgyzstan	2005	Yes
Latvia	2000	Yes
Lithuania	2000	Yes
Madagascar	2003	No
Malawi	1998	No
Malaysia	2000	No
Mauritius	2005	Yes
Mexico	2005	Yes

Table B Self-employment data sample and sources – continued from previous page

Country Name	ILO Table 1. C Year	VA sample
Moldova, Rep. of	2000	Yes
Morocco	2003	Yes
Netherlands	2000	Yes
New Zealand	2000	No
Norway	2000	Yes
Oman	2000	Yes
Pakistan	2002	No
Panama	2005	No
Peru	2000 *	Yes
Philippines	2005	Yes
Poland	2000	Yes
Portugal	2005	Yes
Romania	2005	Yes
Rwanda	1996	No
Singapore	2002	No
Slovakia	2005	Yes
Slovenia	2005	Yes
Spain	2000	Yes
Sweden	2000	Yes
Thailand	2005	Yes
Turkey	2005	No
Ukraine	2000	Yes
United Arab Emirates	2005	Yes
United Kingdom	2000	Yes
United States	2005	Yes
Uruguay	2000 *	Yes
Venezuela	1997	Yes

* urban only

Table C: Self-employment by sector

Country Name	s_1	s_2	s_3	s	ILO Table 1. C	d
Armenia	0.51	0.14	0.24	0.28	No	0.85
Australia	0.51	0.04	0.14	0.16	Yes	1.00
Austria	0.83	0.03	0.08	0.13	Yes	0.98
Belarus	0.58	0.07	0.18	0.22	No	0.96
Belgium	0.77	0.04	0.15	0.16	Yes	1.06
Brazil	0.72	0.17	0.28	0.37	Yes	0.83
Bulgaria	0.54	0.00	0.10	0.14	Yes	0.86
Cameroon	0.84	0.29	0.40	0.64	No	0.79
Canada	0.54	0.06	0.14	0.16	Yes	1.09
Chile	0.44	0.10	0.30	0.32	Yes	0.98
China	0.90	0.37	0.49	0.78	No	0.82
Colombia	0.56	0.69	0.49	0.51	Yes	0.87
Costa Rica	0.37	0.17	0.26	0.28	Yes	0.94
Cuba	0.60	0.16	0.26	0.31	No	0.87
Czech Republic	0.34	0.04	0.16	0.17	Yes	1.06
Denmark	0.51	0.00	0.07	0.08	Yes	1.05
Dominican Republic	0.59	0.15	0.26	0.31	No	0.87
Egypt	0.75	0.03	0.21	0.53	Yes	0.87
Estonia	0.32	0.03	0.07	0.08	Yes	1.02
Finland	0.70	0.33	0.10	0.13	Yes	1.02
France	0.70	0.02	0.09	0.11	Yes	1.01
Germany	0.51	0.01	0.10	0.11	Yes	1.00
Greece	0.95	0.05	0.28	0.38	Yes	0.87
Guatemala	0.76	0.18	0.29	0.48	No	0.85
Honduras	0.66	0.65	0.49	0.55	Yes	0.92
Hungary	0.35	0.02	0.13	0.14	Yes	1.05
India	0.90	0.39	0.51	0.77	No	0.80
Indonesia	0.87	0.56	0.51	0.67	Yes	1.17
Iran	0.85	0.03	0.38	0.50	Yes	0.74
Ireland	0.81	0.07	0.13	0.17	Yes	1.01
Israel	0.38	0.00	0.12	0.13	Yes	0.94
Italy	0.64	0.33	0.44	0.45	Yes	0.98
Jamaica	0.55	0.12	0.22	0.31	No	0.86
Japan	0.85	0.00	0.12	0.15	Yes	0.97
Jordan	0.54	0.15	0.25	0.30	No	0.86
Kazakhstan	0.74	0.00	0.20	0.38	Yes	1.27
Kenya	0.99	0.37	0.48	0.81	No	0.77
Korea, Rep. of	0.92	0.11	0.31	0.38	Yes	0.78
Kuwait	0.44	0.00	0.04	0.04	No	0.99
Kyrgyzstan	0.94	0.01	0.24	0.51	Yes	0.57
Latvia	0.63	0.00	0.06	0.14	Yes	1.04
Lithuania	0.71	0.00	0.07	0.19	Yes	1.00

Table C Self-employment by sector – continued from previous page

Country Name	s_1	s_2	s_3	s	ILO Table 1. C	d
Macedonia	0.48	0.13	0.23	0.28	No	0.84
Mauritius	0.35	0.00	0.18	0.19	Yes	0.91
Mexico	0.66	0.09	0.31	0.36	Yes	0.82
Moldova, Rep. of	0.62	0.10	0.10	0.35	Yes	0.86
Mongolia	0.56	0.26	0.36	0.46	No	0.78
Morocco	0.88	0.04	0.39	0.60	Yes	0.88
Mozambique	0.90	0.35	0.46	0.83	No	0.77
Namibia	0.64	0.11	0.21	0.38	No	0.86
Netherlands	0.51	0.00	0.10	0.11	Yes	0.99
Niger	0.90	0.40	0.51	0.91	No	0.75
Nigeria	0.83	0.37	0.49	0.61	No	0.78
Norway	0.62	0.00	0.05	0.07	Yes	1.03
Oman	0.79	0.01	0.08	0.12	Yes	1.93
Papua New Guinea	0.88	0.29	0.40	0.73	No	0.77
Paraguay	0.67	0.22	0.33	0.48	No	0.80
Peru	0.73	0.24	0.60	0.48	No	0.71
Philippines	0.76	0.53	0.34	0.50	Yes	0.58
Poland	0.89	0.00	0.12	0.25	Yes	0.93
Portugal	0.82	0.05	0.17	0.24	Yes	0.94
Romania	0.94	0.01	0.07	0.34	Yes	0.96
Russian Federation	0.72	0.22	0.33	0.36	No	0.89
Senegal	0.93	0.33	0.44	0.77	No	0.77
Slovakia	0.11	0.01	0.12	0.12	Yes	1.03
Slovenia	0.86	0.00	0.08	0.15	Yes	1.04
South Africa	0.65	0.16	0.27	0.30	No	0.91
Spain	0.49	0.04	0.16	0.19	Yes	0.95
Sri Lanka	0.80	0.23	0.34	0.54	No	0.82
Sudan	0.91	0.32	0.43	0.69	No	0.78
Sweden	0.63	0.11	0.09	0.10	Yes	1.06
Taiwan	0.60	0.06	0.17	0.18	No	1.00
Thailand	0.84	0.03	0.36	0.56	Yes	0.63
Trinidad and Tobago	0.44	0.00	0.09	0.13	No	0.97
Tunisia	0.65	0.12	0.22	0.32	No	0.91
Ukraine	0.34	0.00	0.04	0.10	Yes	0.82
United Arab Emirates	0.01	0.01	0.03	0.03	Yes	0.94
United Kingdom	0.48	0.04	0.11	0.12	Yes	1.02
United States	0.43	0.02	0.07	0.08	Yes	0.96
Uruguay	0.53	0.10	0.18	0.25	No	0.89
Venezuela	0.52	0.07	0.36	0.37	Yes	0.88

Table D: Payment shares and factor prices

Country Name	Code	Sector based				Aggregate			
		α_L	α_K	w_u	r	α_L	α_K	w_u	r
Armenia	ARM	0.59	0.31	3,356	16.6	0.61	0.23	3,449	12.0
Australia	AUS	0.63	0.30	13,406	9.9	0.64	0.27	13,517	8.9
Austria	AUT	0.61	0.38	15,782	11.2	0.63	0.34	16,259	10.2
Belarus	BLR	0.68	0.28	8,514	10.6	0.71	0.18	8,945	6.6
Belgium	BEL	0.68	0.32	17,043	10.6	0.68	0.31	17,036	10.2
Brazil	BRA	0.63	0.34	4,992	12.1	0.75	0.11	6,002	3.8
Bulgaria	BGR	0.45	0.47	3,281	14.0	0.47	0.34	3,403	10.2
Cameroon	CMR	0.38	0.45	1,318	15.9	0.56	0.14	1,962	4.9
Canada	CAN	0.67	0.25	13,592	9.9	0.68	0.23	13,612	9.0
Chile	CHL	0.58	0.26	8,770	11.6	0.60	0.20	9,074	8.9
China	CHN	0.71	0.21	3,336	6.1	2.16	0.12	3,735	3.5
Colombia	COL	0.66	0.26	4,343	10.0	0.70	0.14	4,615	5.6
Costa Rica	CRI	0.67	0.30	6,708	11.4	0.70	0.16	7,010	6.1
Cuba	CUB	0.49	0.47	3,422	23.1	0.56	-	3,901	-
Czech Republic	CZE	0.58	0.41	6,664	10.7	0.58	0.38	6,652	10.1
Denmark	DNK	0.68	0.28	15,010	10.0	0.69	0.27	15,109	9.9
Dominican Republic	DOM	0.41	0.56	3,542	23.9	0.44	0.35	3,807	15.1
Egypt, Arab Rep.	EGY	0.37	0.45	2,933	22.3	0.55	0.17	4,298	8.6
Estonia	EST	0.55	0.43	5,589	9.9	0.55	-	5,608	-
Finland	FIN	0.63	0.35	13,742	12.0	0.64	0.30	13,895	10.3
France	FRA	0.67	0.32	15,613	11.0	0.68	0.30	15,818	10.1
Germany	GER	0.63	0.37	11,955	11.4	0.64	0.34	12,053	10.8
Greece	GRC	0.51	0.48	10,791	16.2	0.59	0.37	12,553	12.6
Guatemala	GTM	0.50	0.44	4,815	17.5	0.65	0.09	6,234	3.4
Honduras	HND	0.89	0.06	3,886	1.8	1.06	0.05	3,499	1.5
Hungary	HUN	0.63	0.34	7,992	10.4	0.63	0.32	7,988	9.6
India	IND	0.62	0.30	2,997	10.4	1.32	0.08	3,867	2.9
Indonesia	IDN	0.70	0.19	3,625	5.2	0.95	0.09	4,133	2.5
Iran, Islamic Rep.	IRN	0.38	0.33	3,976	8.3	0.47	0.20	4,895	4.8
Ireland	IRL	0.55	0.44	14,383	16.3	0.56	0.40	14,726	14.8
Israel	ISR	0.63	0.36	11,762	13.1	0.64	0.33	11,900	11.9
Italy	ITA	0.83	0.16	20,816	5.2	0.84	0.18	20,175	5.8
Jamaica	JAM	0.62	0.33	4,185	7.2	0.71	0.21	4,771	4.6
Japan	JPN	0.65	0.34	12,348	8.4	0.67	0.32	12,760	7.9
Jordan	JOR	0.54	0.43	3,608	10.0	0.59	0.29	3,928	6.9
Kazakhstan	KAZ	0.48	0.38	4,191	12.7	0.56	-	4,964	-
Kenya	KEN	0.80	0.10	1,568	4.6	2.20	0.06	1,564	3.0
Korea, Rep.	KOR	0.71	0.28	10,333	7.6	0.82	0.19	11,716	5.2
Kuwait	KWT	0.23	0.33	9,045	20.6	0.23	0.17	9,059	10.4
Kyrgyz Republic	KGZ	0.41	0.38	1,363	16.3	0.56	0.13	1,853	5.4
Latvia	LVA	0.51	0.47	4,408	20.0	0.55	0.34	4,702	14.6

Table D Payment shares and factor prices – continued from previous page

Country Name	Code	Sector based α_L	α_K	w_u	r	Aggregate α_L	α_K	w_u	r
Lithuania	LTU	0.50	0.47	4,714	23.3	0.55	0.35	5,178	17.1
Macedonia, FYR	MKD	0.56	0.34	2,821	9.0	0.61	0.27	3,061	7.0
Mauritius	MUS	0.49	0.49	8,913	13.8	0.50	0.30	9,110	8.6
Mexico	MEX	0.45	0.52	4,702	16.8	0.50	0.38	5,278	12.2
Moldova	MDA	0.59	0.31	1,915	4.1	0.76	0.12	2,458	1.5
Mongolia	MNG	0.37	0.25	873	5.4	0.46	0.22	1,085	4.6
Morocco	MAR	0.63	0.31	5,151	9.1	0.91	0.14	6,553	4.2
Mozambique	MOZ	0.57	0.31	2,087	14.3	1.62	0.07	2,936	3.4
Namibia	NAM	0.54	0.36	4,936	11.6	0.68	0.20	6,140	6.3
Netherlands	NLD	0.63	0.34	13,403	11.5	0.63	0.33	13,512	11.0
Niger	NER	0.42	0.25	893	10.4	1.96	0.04	1,697	1.7
Nigeria	NGA	0.11	0.27	402	47.3	0.14	0.19	500	33.2
Norway	NOR	0.49	0.28	13,467	9.9	0.50	0.31	13,647	11.0
Oman	OMN	0.28	0.29	7,391	18.5	0.27	0.17	7,156	10.5
Papua New Guinea	PNG	0.36	0.20	1,101	7.6	0.65	0.08	1,972	3.1
Paraguay	PRY	0.62	0.28	2,487	7.4	0.75	-	3,001	-
Peru	PER	0.53	0.38	2,425	13.8	0.49	0.28	2,237	10.4
Philippines	PHL	0.42	0.53	1,616	20.2	0.55	0.20	2,138	7.6
Poland	POL	0.48	0.49	4,971	18.0	0.55	0.31	5,676	11.5
Portugal	PRT	0.70	0.28	11,228	8.3	0.77	0.22	12,231	6.4
Romania	ROM	0.51	0.45	3,301	10.9	0.67	0.20	4,348	4.8
Russian Federation	RUS	0.57	0.37	4,241	5.0	0.61	0.14	4,518	1.9
Senegal	SEN	0.42	0.44	1,054	19.4	1.10	0.10	1,990	4.3
Slovak Republic	SVK	0.47	0.50	4,776	11.6	0.47	0.46	4,760	10.7
Slovenia	SVN	0.67	0.31	10,002	10.7	0.71	-	10,591	-
South Africa	ZAF	0.68	0.27	7,359	11.4	0.73	0.18	7,863	7.5
Spain	ESP	0.64	0.34	14,150	9.8	0.65	0.32	14,550	9.0
Sri Lanka	LKA	0.81	0.14	3,392	4.4	1.24	0.12	3,340	4.0
Sudan	SDN	0.55	0.28	2,406	19.7	0.87	0.04	3,522	2.5
Sweden	SWE	0.71	0.28	13,859	11.1	0.71	0.25	13,936	9.6
Taiwan	TWN	0.66	0.34	11,937	13.1	0.67	-	12,264	-
Thailand	THA	0.44	0.49	3,078	11.7	0.67	0.18	4,661	4.3
Trinidad and Tobago	TTO	0.33	0.45	5,267	18.7	0.35	0.23	5,541	9.5
Tunisia	TUN	0.56	0.35	6,898	9.6	0.62	0.25	7,622	6.9
Ukraine	UKR	0.58	0.34	3,421	5.5	0.62	0.20	3,644	3.2
United Arab Emirates	ARE	0.22	0.46	6,391	19.9	0.22	0.29	6,400	12.8
United Kingdom	GBR	0.68	0.30	15,790	12.9	0.68	0.30	15,820	12.8
United States	USA	0.66	0.32	16,202	13.0	0.66	0.30	16,292	11.9
Uruguay	URY	0.49	0.45	4,710	20.0	0.53	0.25	5,050	11.2
Venezuela, RB	VEN	0.46	0.24	5,395	7.4	0.50	0.17	5,828	5.3

World Bank does not provide resource stocks for 6 countries without aggregate α_K and r.