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Market Imperfections and Asia's Growth Experience**

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Measuring the Miracle: Market Imperfections and Asia's Growth Experience

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Abstract: The newly industrialized economies (NIEs) of Asia are the fastest-growing economies in the world since 1960. A clear understanding of their rapid development remains elusive, with continuing disputes over the roles of technology growth, capital accumulation, and international trade and investment. We reconcile seemingly contradictory explanations by accounting for imperfections in output and capital markets. For instance, in Singapore, growth-accounting studies using quantities (the primal approach) find rising capital-output ratios and a constant labor share; but studies using real factor prices (the dual approach) find a constant user cost. We provide evidence that “favored” firms reaped economic profits and received preferential tax treatment, subsidies, and access to capital—market imperfections that are difficult to capture when implementing the dual approach. Further, declining pure profits can reconcile the constant or rising labor shares in *revenue* in the NIEs with theories of international trade that predict falling labor shares in *cost*. We provide empirical support for the quantitative importance of profits and heterogeneous user costs, describe the two-sector dynamics, and derive measures of technology growth, corrected for the imperfections that we quantify. We then discuss implications for broader disputes about Asian development.

Keywords: Growth accounting, development, market imperfections, trade and factor shares
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In studies of economic growth and development, East Asia's experience looms large. The newly industrialized economies (NIEs) of Singapore, Taiwan, Korea, and Hong Kong are the four fastest-growing economies in the Penn World Tables, with per capita output rising 7 to 8 percent per year from 1960-1996 (see Table 1). Sala-i-Martin et al. (2004) show in cross-country growth regressions that an East Asian dummy is the single most robust explanatory variable. Lucas (1993) and Ventura (1997) argue that this East Asian "Miracle" is one of the most interesting facts of the post-war international growth experience.

A consensus explanation for Asia's growth path, however, remains elusive. How important was technological progress versus factor accumulation? Did international trade allow capital to accumulate rapidly without an equally rapid decline in returns? More generally, what was the role of the public sector?

We address these broad questions by identifying growth-accounting issues that arise with government intervention and market distortions. We assess implications of heterogeneous user costs of capital in the NIEs and, in the case of Singapore, large but declining pure economic profits. Heterogeneity reflected tax incentives and subsidies to direct resources and solicit foreign direct investment (FDI). Unfavored firms faced a higher cost of capital while favored firms earned large economic profits.

This two-sector perspective allows us to reconcile prominent, yet mutually exclusive, descriptions of Asia's development. First, growth-accounting studies reach conflicting results depending on whether one looks at "primal" (quantity-based) or "dual" (factor-price-based) measures of total factor productivity (TFP). Second, the growth accounting studies (and the national accounts) report constant or rising labor shares, which are inconsistent with explanations that emphasize export-oriented growth in capital-intensive sectors.

Young's (1992, 1994, 1995) careful primal growth accounting established the new conventional wisdom that, though several of the NIEs had modest TFP growth, others had little or none (see also Kim and Lau, 1994). Growth reflected accumulation of capital and labor. Hsieh (2002), however, challenges this view using the dual. He finds that in the NIEs, especially in Singapore, TFP grew more quickly (see Table 1). These apparently contradictory results reflect the following puzzle. Labor-income shares were generally stable or rising. Hence, the rising capital-output ratios behind the weak primal TFP growth imply sharp declines in returns to capital; but, especially in Singapore, reasonable user-cost measures are flat.

Pure profits and heterogeneous user costs resolve this puzzle. Suppose the user cost of capital is observed for only part of the economy. It misses pure profits, preferential tax treatment, and investment

subsidies to targeted firms. Observed dual TFP then applies to unfavored firms only. Primal TFP, however, takes payments to capital as a residual. Hence, it incorporates profits and heterogenous user costs. If the profit rate falls and favoritism rises, then dual TFP growth exceeds primal TFP growth.

Unlike the growth accounting studies, several description of Asia's growth specifically focus on the role of international trade. Ventura (1997) emphasizes that small open economies can accumulate capital without rapidly diminishing returns. As production shifts to support the export of capital-intensive goods, rapid growth in capital and output can occur even with constant technology. Romalis (2004) shows that trade data are consistent with this shift—an application of the Rybczynski theorem. These appealing explanations of the importance of trade for growth, however, imply increasing capital shares and declining labor shares; but in the data, only Hong Kong shows a decline in labor's share of income over the 1970-90 period.

Declining profits reconcile flat or rising labor shares with a shift towards capital-intensive production because profits drive a wedge between factor shares in revenue and in cost. We estimate factor shares in cost using data on the industry composition of output in each country, combined with international data on industry factor shares. In most cases, the industry composition of output did, indeed, shift steadily towards capital-intensive sectors as Romalis' results and Ventura's theory predict, implying a rise in capital's share of costs. Hence, in contrast to a face-value interpretation of the original growth-accounting results, our explanation allows an important role for trade in the NIEs' sustained rapid growth.

More generally, we derive aggregate growth-accounting implications in a two-sector economy and show the link between standard TFP growth and technology change. For Singapore, we combine primal and dual results to shed light on sectoral and aggregate dynamics. For firms receiving preferential treatment, even the primal results were insufficiently pessimistic: Output grew nearly 10 percent per year for two decades, with sharply negative technology growth. The unfavored sector had annual output growth of about 6 percent with positive technology growth. Overall, technology growth was slightly negative.

Our interpretation of the dual-primal divergence is more plausible than the main alternatives. First, Hsieh suggests, with little evidence, that there were massive national accounting errors. We discuss this hypothesis (and its difficulties) in an appendix. Second, Young dismisses the dual calculations, in part because they ignore key tax benefits and are not appropriate for all firms. We agree that these issues are central, but find the pattern of mismeasurement economically important. The two methods differ because a

subset of the economy earned very large profits and received government favoritism that grew over time.¹

In sum, we provide a two-sector re-interpretation of the growth-accounting results. Output and capital intensity rose in the favored sector, where technology growth was abysmal. Since this sector received large quantities of foreign direct investment, our results suggest that policies designed to lure FDI did not, in fact, raise overall TFP through technology transfer.

I. Primal and Dual Measures of Productivity

With consistent accounting data, primal and dual TFP are identical. With independent quantity and price data for the NIEs, however, they look substantially different. This section discusses the identities as well as a simple economic environment, with market distortions, in which the two measures might differ.

A. Manipulating Accounting Identities

The national accounts identity states that nominal output PY equals nominal factor income. One can force the identity to hold by defining payments to capital as a residual, $PY - WL$. P is the price deflator, Y is real output, W is the nominal wage, and L is total labor input. Conceptually, measured payments to capital include required payments RK —where R is the implicit rental cost (or user cost) and K is capital input—plus any pure profits (or losses) Π . We provide economic definitions of R and Π below. Thus:

$$PY = WL + (R + \Pi/K) K. \quad (1)$$

For any variable J , let \hat{j} be the percent change, dJ/J . $\widehat{(r + \pi/k)}$ is growth in residual payments to capital; we combine R and Π/K because, with only accounting data, we cannot distinguish them. s_L is labor's share in output, WL/PY . The residual capital share is then $(1-s_L)$. Totally differentiating (1) yields $\hat{y} + \hat{p} = [s_L \hat{l} + (1-s_L) \hat{k}] + [s_L \hat{w} + (1-s_L) \widehat{(r + \pi/k)}]$. Rearranging shows that “primal” TFP growth—output growth less share-weighted input growth—equals a “dual” weighted average of real factor price growth:²

¹ Can we be sure that neither Young nor Hsieh made large errors in their calculations? Young's primal data match up well with the “official” data on output and labor input; capital input growth recomputed from the underlying investment data also line up well. We re-examined Hsieh's sources and calculations and are not aware of major errors (though we interpret his results differently). In particular, the national accounts show a rapid increase in the capital-output ratio of about three percent per year, whereas reasonable user-cost estimates are flat. Feenstra and Reinsdorf (2003) consider whether stochastic tastes or technologies could lead to large standard errors in the dual. They conclude that if one compares Young and Hsieh's results for periods of 15 years or longer, the differences are statistically significant. This is consistent with our explanation that Hsieh correctly measured capital costs for the subset of the economy that he observed. Barro (1999) also discusses possible interpretations of the dual-primal discrepancy for the national accounts.

² Henceforth, for convenience we often use TFP to refer to its *growth* rate. When possible, we omit time subscripts.

$$TFP_{\text{Primal}} \equiv \hat{y} - [s_L \hat{l} + (1 - s_L) \hat{k}] = [s_L (\hat{w} - \hat{p}) + (1 - s_L) (\widehat{r + \pi / k} - \hat{p})] \quad (2)$$

Thus, if identity (1) holds, then primal and dual TFP are identical. But one can estimate the dual with independent factor-price data. Hsieh (2002), in particular, finds measures of real interest rates i_t for the NIEs and calculates Hall-Jorgenson (1967) user costs of capital, R_{Dual} , as $(i_t + \delta)q_t$, where q_t is the investment deflator, i_t is the real interest rate (defined in terms of asset inflation \hat{q}_t), and δ is the depreciation rate. He also estimates nominal wages. He deflates with the GDP deflator,³ assumes zero economic profits, and uses Young's estimated factor shares to calculate:⁴ $TFP_{\text{Dual}} \equiv s_L (\hat{w}_{\text{Dual}} - \hat{p}_{\text{Dual}}) + (1 - s_L) (\hat{r}_{\text{Dual}} - \hat{p}_{\text{Dual}})$. Hence, the primal and dual differ if growth in either estimated wages or capital-payments differ:

$$TFP_{\text{Dual}} - TFP_{\text{Primal}} = s_L (\hat{w}_{\text{Dual}} - \hat{w}) + (1 - s_L) (\hat{r}_{\text{Dual}} - \widehat{r + \pi / k}) \quad (3)$$

Table 2 shows this decomposition with data from Young (1995, 1998) and Hsieh (2002). Lines 1 to 3 show the items on the right side of equation (3); lines 4a and 4b show primal and dual TFP growth. Lines 5 and 6, respectively, show the contribution of wages and capital payments to the dual-primal difference.

Tables 1 and 2 show that the primal and dual differ markedly only in Singapore and Taiwan. Wages play a sizeable role in Singapore and account for the bulk of the difference in Taiwan. Hsieh (2002) has little discussion of the role of wages.⁵ We view the wage discrepancies as largely a measurement issue; in what

Discrete-time Tornquist indices approximate the continuous time identity. In BLS data for U.S. TFP (1948-2002), the approximation error between the primal and the dual is negligible, so we continue to treat equation (2) as an identity.

³ Hsieh (2002) and Young (1995, 1998) provide estimates of real factor price growth only. For notational simplicity, we assume the primal and dual use the same output deflator, so that differences are the same in real or nominal terms.

⁴ Hsieh allows for multiple types of capital and labor (see Hsieh 2002, pp505-506), as does Young. Nominal wage growth is then $\hat{w} + \hat{l} \equiv \sum s_j \hat{w}_j + \sum s_j \hat{l}_j$, where s_j is the labor-income share for workers of characteristic j (e.g., education). One can write $\hat{l} = \widehat{\sum L_j} + (\sum s_j \hat{l}_j - \widehat{\sum L_j}) = \widehat{emp} + \widehat{qual}$, i.e., the sum of employment growth and labor quality growth. Thus, measured wage growth is reduced by the amount of the labor-quality correction.

⁵ The two use slightly different source data on wages and employment. Young measures $\hat{l} = \sum s_j \hat{l}_j$. He benchmarks to total labor compensation, which imposes the identity that $WL = \sum W_j L_j$. Hence, his estimate of implicit wage growth,

$\hat{w}_{\text{Primal}} = (\hat{w} + \hat{l}) - \sum s_j \hat{l}_j$, is necessarily consistent with the aggregate compensation figures. Hsieh measures

$\hat{w}_{\text{Dual}} = \sum s_j \hat{l}_j$ directly, so he doesn't need to benchmark to aggregate compensation. Implicitly, two factors "explain" the wage differences. First, Hsieh's survey data have less growth in employment than the official tabulations and he implicitly has less labor quality growth than Young (1995); for given growth in nominal compensation, these factors imply faster wage growth. Second, Hsieh's figures on total labor compensation rises from 25 percent of GDP in 1973 to 37 percent of GDP in 1990. Hence, his show larger growth in nominal labor compensation.. Young (1998) questions the reliability of Hsieh's wage data.

follows, we focus on economic or conceptual issues raised by capital's contribution, line 6.

In Singapore, capital account for most (1.6 percentage points) of the dual-primal gap. The puzzle is that weak primal TFP performance implies sharp declines in capital returns, but estimated user-costs are flat.

B. A two-sector economic framework with profits and user-cost heterogeneity

We now discuss a simple economic environment in which, because of pure profits and capital-cost heterogeneity, the primal and dual might yield different results. We consider a partial equilibrium environment with two firms, indexed by $i = F$ or U (ultimately, "favored" and "unfavored") that seek to maximize shareholder wealth. We abstract from uncertainty or factor adjustment costs.

Capital K and labor L are homogeneous, with $K_t = K_{F,t} + K_{U,t}$ and $L_t = L_{F,t} + L_{U,t}$. Each firm has a Cobb-Douglas production function, $Y_{i,t} = A_{i,t} K_{i,t}^{\alpha_i} L_{i,t}^{1-\alpha_i}$, where $A_{i,t}$ is the firm's technology. Equity-financed firms seek to maximize the present discounted value of cash flow. Cash flow each period is revenue net of wages, capital expenditures, and net taxes paid: $P_{i,t} Y_{i,t} - W_t L_{i,t} - (1 - \kappa_{i,t} - \tau_{i,t} D_{i,t}) I_{i,t} - \tau_{i,t} (P_{i,t} Y_{i,t} - W_t L_{i,t})$. The capital goods price (q) is the numeraire. Firms take the wage, W_t , as given. Firms deduct wage payments before paying taxes at rate $\tau_{i,t}$. $D_{i,t}$ is the present value of allowances for depreciation in the tax code per dollar of investment; the tax authorities issue a credit of $\tau_{i,t} D_{i,t}$ when the firm undertakes the investment.⁶ $\kappa_{i,t}$ is an investment subsidy, so that $(1 - \kappa_{i,t} - \tau_{i,t} D_{i,t}) I_{i,t}$ is the firm's effective net expenditure on capital. If the firm has market power, then price $P_{i,t}$ (relative to the capital goods price) depends on its choice of output: $P_{i,t}^j(Y_{i,t})$. Capital accumulation depends on investment $I_{i,t}$ and depreciation: $K_{i,t+1} = (1 - \delta) K_{i,t} + I_{i,t}$. i_t is the real interest rate between $t-1$ and t (with $i_0 = 0$), again defined in terms of the numeraire q , so that $\prod_{j=0}^t (1 + i_j)^{-1}$ is the firm's discount rate from period 0 to period t . We assume perfect foresight and write the problem:

$$\begin{aligned} \text{Max } W_0 &= \sum_{t=0}^{\infty} \left(\prod_{j=0}^t (1 + i_j)^{-1} \right) \left[(1 - \tau_{i,t}) (P_{i,t}^j(Y_{i,t}) Y_{i,t} - W_t L_{i,t}) - (1 - \kappa_{i,t} - \tau_{i,t} D_{i,t}) I_{i,t} \right] \\ \text{s.t. } \quad Y_{i,t} &= A_{i,t} K_{i,t}^{\alpha_i} L_{i,t}^{1-\alpha_i} \\ K_{i,t+1} &= (1 - \delta) K_{i,t} + I_{i,t}, \text{ and } K_{i,0} \text{ given} \end{aligned} \quad (5)$$

⁶ With constant tax rates, this formulation is equivalent to allowing firms to deduct depreciation each period against

