Sources of Vietnam's Economic Growth

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Abstract

This paper first estimates Cobb-Douglas production functions for Vietnam's economy using annual data in 1975-2003. Then the paper measures the contribution of capital formation, labor, and technological progress to the growth of the economy, the effects of major internal and external shocks on output, the impact of economic reforms (*doi moi*) since the end of 1986, the rates of returns to capital and labor. Two major findings are: (i) technological progress was statistically absent in the growth of the Vietnamese economy throughout the study period; (ii) the most important source of economic growth is capital accumulation.

Keywords: Production function; technological progress; capital formation; economic reforms; economic growth; Vietnam.

JEL classification: D24, O40

I. INTRODUCTION

As detailed below, the failure of a Soviet-style central planning economic system, which was associated with two economic crises in the end of 1970s and mid-1980s, forced the Vietnamese government to adopt in the end of 1986 a wide range of reform policies, widely known as *doi moi*, to build a market-based economy. As a result, high and sustainable rates of economic growth have been achieved since then, albeit with some slowdowns in the end of the 2000s, which was thought to be partly due to negative effects of the 1997 Asian economics crisis. According to Table 1, the average growth rate of GDP in the reform period (1987-2003) almost doubled that in the pre-reform period (1975-1986), 7.2 percent and 3.7 percent, respectively. Suffice it to say, this is an economic miracle in the contemporary world economic history, especially for an economy in transition like Vietnam's.

[Insert Table 1 here]

A quick check of the data on the growth rates of capital formation and labor reported in Table 1 suggests that the high growth rate of capital formation in the reform period, which averaged to 14.7 percent as compared to a mere 3.2 percent in the pre-reform period, was likely a main factor behind this outstanding economic performance. There also is a

possibility that GDP growth has been fueled significantly by an improvement in total productivity as a result of *doi moi*, which has exerted positive effects on, among others, resource allocation, as well as production organization and techniques, etc.

Surprisingly, in spite of a large number of studies that attempt to analyze the effects of *doi moi* on various aspects of the Vietnamese economy,[1] these and other related important issues have not been discussed rigorously, and the existing literature has failed to ascertain the contribution of capital formation, labor, and technological progress to Vietnam's economic success. Furthermore, there has been no quantitative study to measure explicitly the effects of upheavals (the domestic economic crises in the end of 1970s and mid-1980s, the collapse of the Soviet Union in 1989, and the 1997 Asian financial crisis) and *doi moi* on economic growth and productivity improvement in Vietnam.

Against this backdrop, in the present study we rely on annual data released by the United Nations (and other official sources, where necessary) to discuss the following important questions in a production function framework: to what extent have capital, labor, and technological progress contributed to economic growth in Vietnam? To what extent has the economy's output been affected by the economic crisis in 1979-80, the collapse of the Soviet Union in 1989, the macroeconomic crisis in 1985-86, and the external shocks

associated with the 1997 regional crisis? What are the impacts of *doi moi* on economic growth and productivity improvement? What has been the marginal productivity of capital and labor? How has capital formation been financed?

The rest of the paper is organized as follows. Section 2 reviews some important facts concerning the Vietnamese economy. In Section 3, attempts are made to build series of capital stock to be used in production functions. This section also discusses briefly the growth trend of total productivity throughout the years. In Section 4, the role of capital formation, the effects of major internal and external shocks and changes on economic growth, the degree of technological progress, and the marginal productivity of capital and labor are analyzed in a production function framework. Findings and their implications are summarized in the final section.

2. ECONOMIC PERFORMANCE: SOME STYLIZED FACTS

Vietnam was reunited in 1975 after 30 years of war and division. The communist government quickly applied a socialist centrally planned economic system in the whole country in 1976. Under this system, private ownership was not recognized or was discriminated against state and collective ownerships. In addition, emphasis was given to

the development of heavy industry at the expense of agriculture and light industry.[2] As a result, thousands of agricultural cooperatives and production collectives as well as state owned enterprises (SOEs) were created within a couple of years. In practice, almost all peasant households in the North and about 36 percent of those in the South were forced to join agricultural cooperatives and production collectives by 1980. In non-agricultural sectors, SOEs and SOE-private joint ventures accounted for as much as 88 percent of national assets. In general, the state owns all national resources and essential production means.

Nevertheless, massive state and collective ownerships did not bring about the expected outcomes. The economy stagnated in 1977-78 (growing at a rate of 2 percent and 2.9 percent, respectively; see Table 1). This was mainly because of deficiencies inherent in the economic model itself. In agriculture, lack of incentives as a result of collectivization had a detrimental effect on agricultural output and productivity.[3] Natural disasters in these years caused further losses to this sector. These resulted in sharp decreases of agriculture's output in 1977-78 as this sector grew at the rates of –5.6 percent and –1.9 percent before recovering in the following year (increasing by 2.8 percent, Table 2).

[Insert Table 2 here]

Before proceeding further, it is necessary to have a brief discussion about the data, which are cited in Tables 1 and 2. Calculations using data on GDP at 1990 prices broken down by economic sector from the United Nations source show that the growth rates of economic sectors were exactly the same as the growth rate of the economy as a whole before 1985. Besides, the GDP shares of economic sectors remained unchanged through 1984. These seem to us to be unrealistic. We hence use other official data, which are cited in Table 2, to calculate the growth rates and shares of economic sectors in *Gross Social Production* (GSP) at 1982 prices for the years before 1985. Note further that because the data on GDP value of the whole economy in the full period (1975-2003) and that of economic sectors in 1987 onward from the United Nations source are comparable with those from other official sources,[4] and because only in the former source can one find, among others, data on consumption and capital formation, which are crucial to the present study's analysis, we shall therefore rely on this source where applicable.

In the industrial sector, the government's ambition for rapid industrialization and economic growth had led to an excessive state investment in the development of production capacity. However, the investment efficiency was so low (due mainly to economic mismanagement, administrative inefficiency, and bureaucratic inertia) that many

development projects were left uncompleted and the capacity utilization rate of others stood at less than 50 percent (Kim 1994). Consequently, after a short boom in 1977-78 (10.8 percent and 8.2 percent, respectively; Table 2), this sector's output declined severely in the next two consecutive years (- 4.7 percent and –10.3 percent in 1979 and 1980, respectively).

Poor performance in agriculture and industry, combined with great economic costs incurred by Vietnam's invasion of Cambodia in December 1978 and its border war with China in early 1979,[5] had led the country to the edge of a collapse, with the growth rate of GDP turning to negative in 1979-80 (-1.9 percent and -4.8 percent, respectively). Therefore, this period of time has sometimes been referred to as an economic crisis period.

Faced with these great upheavals, the government had no choice but to adjust its development model. A greater degree of private ownership was then allowed and several New Economic Policies, which were piecemeal reform measures toward market disciplines in essence, were introduced in 1981 to encourage all economic agents, including individuals, to actively involve in production and circulation of goods. In agriculture, where the reform attempt was boldest, forced collectivization was suspended and an output contract system was adopted giving individual peasant households more autonomy in

production and the right to sell their surpluses on the open market. In addition, they were allowed to cultivate land not in use by cooperatives. These limited reform measures immediately brought about a short-run improvement in this sector's performance. Agriculture output increased impressively in the following year at the rate of 11.3 percent before slowing down in 1983 and 1984.

Similarly, there were also some experimental reform measures in the industry sector in 1981. Industrial SOEs were given more autonomy in their production and allowed to involve in other productive activities outside state obligations. Material incentives were also applied to improve workers' productivity. The result of this decentralization in economic management was very encouraging. Industrial output recorded a nearly 9 percent rate of growth in 1982 and even much higher in 1983-84 (above 13 percent).

The improved performance of agriculture and, in particular, industry had fueled the recovery and growth of the whole economy through 1984.[6] GDP expanded at a rate of 4 percent in 1981, and more than twice that rate in 1982 (8.7 percent). After a slight slowdown in 1983 (6.3 percent), the growth gained its momentum again and reached the level of 8.4 percent in 1984.

However, the positive effects on the economy brought about by these piecemeal reform

measures wore off in mid 1980s because the deep structural problems of the economy remained unsolved. In practice, the country leaders strongly defended the socialist disciplines in their development strategy while allowing for some microeconomic market-oriented reforms as mentioned above, and just all. The economy continued to be centrally planned and the state sector continued to be subsidized heavily despite its low efficiency and the searing size of budget deficits, which was estimated at about 37 percent of total budget revenue in 1985 (GSO, 1988). Wide-scaled collectivization, particularly in the South, resumed in 1985. Also in this year a premature reform in prices and state worker's wages was implemented aiming at liberalizing prices of some selected material inputs and substantially increasing state workers' basic wages and regular salaries. This reform accelerated inflation, which had been triggered by large increases in money supply by the central bank to finance widening budget deficits. As a result, inflation was reinforced in 1985 at a rate of approximately 200 percent on a year on year basis against that of 165 percent in 1984. The situation became even much worse in 1986 when prices shot up almost by 500 percent, and this hyperinflation was not contained until 1989 (at a rate of 35 percent).

All together, these factors had put a break on the economy. According to Table 2,

agriculture and, particularly, industry showed significant slowdowns in 1985-86 (2.5 percent and 4.8 percent for agriculture, 9.9 percent and 6.2 percent for industry, respectively). Consequently, the growth rates of GDP fell in these two years, most considerably in 1986 (6.2 percent and 2.9 percent, respectively), as compared to 8.4 percent in 1984. Characterized by hyperinflation, foot shortages, and the stagnation of the economy, this period is sometimes referred to as a macroeconomic crisis period.

It should, however, be noted that the growth trends of these sectors in 1985-86 observed in Table 2 vary significantly from those in Table 1, which are based on the United Nations data. Table 1 shows, on the one hand, a significant improvement in industry's performance as both mining and utilities and manufacturing rapidly expanded, at a rate of 12.8 percent and 12.6 percent, respectively, after crashing in 1985. On the other hand, agriculture grew by only 3 percent in 1986 compared with 9.9 percent in 1985. These large variations notwithstanding, the combined growth of these and other sectors seems to correspond to the observation that GDP growth slowed down significantly in 1985 and, in particular, 1986.[7]

The macroeconomic crisis in 1985-86 prompted the government to accept even more radical measures to reform the economy. Correspondingly, a comprehensive reform

program, *doi moi*, was introduced in December 1986. In this program, among other things, the development of the private sector was emphasized; the strategy for industrialization was altered in that priority was given to the development of light industry instead of heavy industry as before; exports and inward foreign direct investment (FDI) were encouraged; and the role of SOEs were reduced. It should be noted that in the first two years of the reform period (1987-1988) only part of the reform program was implemented and on a gradual basis. However, the early improvement in economic performance brought about by reform measures in these years, together with pressing external developments in the late 1980s (e.g., the collapse of the Soviet Union and the corresponding loss of major traditional export markets, as well as cheap imports and aids) had prompted the government to implement a more radical, comprehensive reform program in 1989 with a big bang approach.

As shown in Tables 1 and 3, the economy recovered quickly from the 1985-1986 crisis, with GDP expanding by 4 percent in 1987 and 5.2 percent in 1988. Due to the collapse of the Soviet Union in 1989, manufacturing was badly affected, and the growth rate of GDP slowed down again, at 4.7 percent. As a result of the 1989 reform program, the economy entered a new development phase in which high and sustained growth was achieved until

1997. Significant slowdowns were seen in 1998 and 1999, though at respectable rates of 5.8 percent and 4.8 percent, respectively, compared with negative growth rates of some neighboring countries badly hit by the regional financial crisis. Most observers have argued that the 1997 regional crisis was directly responsible for the slowdowns in GDP growth in 1998-1999. For example, World Bank (1998) estimated that the impact of the crisis on the Vietnamese economy was about US$3 billion in 1998 (i.e., equivalent to 11 percent of GDP in that year).[8] GDP growth was over 7 percent in recent years, which was relatively high in the Asian dynamic region.

[Insert Table 3 here]

We turn now to compare the structure of the economy in terms of sectoral share and expenditure on GDP in the pre- and reform periods. Much of the high growth of GDP in the reform period can be attributed to the rapid growth of mining and utilities, and construction, as well as manufacturing (9.8 percent, 9 percent, and 8.2 percent, respectively; see Table 1). In some contrast, if in the pre-reform period the agriculture sector grew at a rate slightly higher than the whole economy (4.1 percent versus 3.7 percent), it grew the most slowly in the reform period. As a result, the share of agriculture in GDP was on a steadily decreasing trend, from an average of 37 percent in the pre-reform period to about 23 percent in recent

years, demonstrating a significant change in the structure of the economy.

With regard to the structure of expenditure on GDP, during the pre-reform period the share of consumption in real GDP was astonishingly high, averaging to 101.6 percent (Table 4). The share of capital formation was relatively low, at 12.3 percent. Thus, the fact that the consumption was greater than GDP in all years in this period indicates that the country's investment was totally financed by foreign aids and borrowings, as represented by the average trade deficit of 13.8 percent of GDP.[9] Put differently, domestic savings were totally non-existent.

[Insert Table 4 here]

In the reform period, the picture changed considerably. Although consumption continued to increase at an average growth rate of 5.2 percent, which was higher than in the previous period (3.7 percent), but its rate of growth was slower than that of GDP growth (7.2 percent, Table 1). As a result, the average share of GDP devoted to consumption contracted significantly to 83.1 percent.[10] Nevertheless, this contraction was not sufficiently large to cover the high rate of capital formulation, which increased to 14 percent in 2003 (averaging to 14.7 percent in this period) as compared to a mere 3.2 percent in the pre-reform period. This means that a large part of this growth was still financed by foreign

resources, as represented by the large trade deficit of 7.3 percent of GDP during the same period (Table 4). It is worth noting that this reliance does not seem to have reduced recently.

3. CAPITAL STOCK AND TOTAL PRODUCTIVITY

Because a production function framework is adopted to analyze the effects of changes and shocks on the Vietnamese economy, it is crucial to have the data on capital stock that is not readily available from the existing sources. In this paper we shall estimate capital stock in year t (or K_t) from the following function:

$$K_t = K_{t-1} + I_t \tag{1}$$

where K_{t-1} is the capital stock in the previous year and I_t is the net increase in capital stock in year t. The data on gross capital formation from the United Nations source is, by definition, I_t. We thus need to compute only the capital stock in the initial year, 1975, (denoted by K_{75}) from the following function:

$$K_{75} = k_{75} * Y_{75} \tag{2}$$

where k_{75} is the capital-output ratio (COR) and Y_{75} is the level of GDP in 1975.

To estimate k_{75}, we assume that Vietnam's COR in 1975 was equal to that of China in

the early 1970s. The rationale is that the Chinese economy was also an agrarian, centrally planned economy, with agriculture accounting for around 40 percent of GDP in early 1970s. Therefore, the nature and structure of the Vietnamese economy at least through *doi moi* were similar to a large extent to those of the Chinese economy in early 1970s. Since the COR estimate for China in the early 1970s was around 2, as estimated in Wang and Yao (2003), we assign this value to k_{75} in equation (2) and obtain the first series of capital stock data (denoted by *K3* in Table 5) from equation (1) for the period 1975-2003.

[Insert Table 5 here]

However, the value of 2 for k_{75} in Vietnam seems to be questionable because it is rather high if compared with COR estimates of other regional developing countries (see, e.g., Sundrum (1986), and King and Levine (1994) for the case of Indonesia). Realizing the possible inaccuracy of the initial estimate, we also assign two other lower values, namely 1 and 1.5, to k_{75} and obtain two additional series of capital stock data denoted by *K1*, *K2* as reported in Table 5. These three series of capital stock show different (decreasing) rates of growth.

Plotting log(GDP/labor) against log(capital/labor) as in Figure 1, which is constructed for *K3*, we can see how significant changes in total productivity and, thus, technological

progress have been over year.[11]

[Insert Figure 1 here]

The fact that the points in the figure are fairly close to a straight line (except the points from 1975-80, due to the great upheaval of the 1979-80 economic crisis that caused a setback in capital formation in this period; see Table 1) suggests that productivity improved *insignificantly* throughout most of 1975-2003. This would also mean that significant technological progress have been *absent* in Vietnam during this period. We shall get back to this issue later on.

4. AGGREGATE PRODUCTION FUNCTION

We begin this section by considering a Cobb-Douglas production function in the following form:

$$\log(Y_t) = a + \alpha \log(K_t) + \beta \log(L_t) + T1 \qquad (3)$$

where the denotation is as before, and $T1$ is a linear trend included to test the assumption that total productivity increased at a constant rate throughout the period 1975-2003. The three series of capital stock built earlier (*K1*-*K3*) will be inserted interchangeably into equation (3) to represent K_t. The annual data on Y_t in 1975-2003 are

obtained from the United Nation source as cited in Table 1, while the data for labor force are from the World Bank's *World Development Indicators 2004*.

As discussed earlier, the Vietnamese economy appears to have experienced through several significant shocks and changes, most notably in 1979-80 (the first domestic economic crisis), 1985-86 (the second domestic economic crisis), 1989-90 (the collapse of the Soviet Union), 1998-99 (lagged effects of the 1997 Asian financial crisis), as well as in the 1989-2003 period (when bold reform policies were implemented and, consequently, large structural changes may have been resulted). It is, therefore, necessary to control for the possible effects of these shocks and structural changes on the Vietnamese economy. Here we simply add in the production function a set of dummies for the year(s) when these shocks and changes were thought to have exerted significant effects on the economy. The denotation of and values assigned to these dummies are reported in Appendix Table 1.

In the preliminary estimates of equation (3), it is found that the OLS regressions have very low Durbin-Watson statistics (ranging from 0.3 to 0.6). Both Ljung-Box and Breusch-Godfrey Lagrange multiplier tests for serial correlation suggest that the second-order serial correlation is present.[12] We adopt nonlinear regression techniques to account for this autocorrelation and obtain the estimated equations as shown in Table 6.[13]

Note that the Durbin-Watson statistics now are close to 2 in all regressions. Note also that, in the preliminary regressions, all dummies but *D1980* are statistically insignificant even at the 10 percent level for all three series of estimated capital stock.[14] Therefore, we report in Table 6 equations that include only *D1980* as a dummy due to space constraints.

[Insert Table 6 here]

We also report *p*-values for the test for constant returns to scale in the production function (denoted by CRS). The *p*-values in regressions (1), (3), and (5) indicate that the hypothesis that the capital and labor exponents sum to 1 cannot be rejected at a high level of confidence in these three regressions. Under the assumption of constant returns to scale, the estimates are given in regressions (2), (4), and (6). It is confirmed in these regressions that significant technological progress was absent in Vietnam throughout 1975-2003 because the coefficients on *T1* are not statistically significant even at the 10 percent level.

In regressions (7)-(12) of Table 6, we test the assumption that technological progress was significant only in the period of bold reform measures, from 1989-2003, by replacing *T1* with *T2*, a trend variable that begins with $t = 1$ in 1989 (see Appendix Table 1). However, the coefficient on *T2* is also statistically insignificant in all these regressions, suggesting further that *doi moi* did not induce significant technological changes and total productivity

improvement. This is also consistent with the finding in the preliminary regressions that *doi moi* did not cause a significant structural change that would lead to improved productivity in the economy as represented by the statistically insignificance of the coefficient on *DM*, the dummy variable for *doi moi*. We therefore proceed to regression (13)-(15), which include no time trend and obtain estimates of coefficients on capital and labor, among others, in order to compute the marginal productivity of capital and labor as shown in Table 7.

[Insert Table 7 here]

The estimates of marginal productivity of capital show a steady decline throughout the study period (except in the first half of the 1980s).[15] Both the absence of technological progress and increased capital stock could be the major factors working toward reducing capital productivity. Note also that the marginal productivity of capital has reached a fairly low level recently. This implies that Vietnam is using capital at a level close to its long-run equilibrium. Put differently, the country has very limited room for absorbing more capital from both domestic and foreign sources, if other things remain unchanged.[16]

On the other hand, the marginal productivity of labor shows an upward trend throughout the study period (except 1979-80), and the increase was particularly marked in

the 1990s. This tendency is consistent with changes in the general wage rate following several significant basic wage rate adjustments by the government.

Table 7 also reports the deviations of actual GDP from the estimates by the regressions (13)-(15) shown in Table 6 as fractions of the latter. With a few exceptions, the economy underperformed through 1997 and the loss of GDP was quite considerable in several years. Total productivity was only improved slightly in 1998 onward, most notably in 2002-03, when several percentage points of GDP were gained. This finding is consistent with the observation in Figure 1 that the slope of the points from 1998 is slightly greater than the slope of the points before. Once again, the marginal effect of *doi moi* on productivity improvement and the absence of technological changes are confirmed.

The observation that productivity was slightly improved (and thus there was a small gain in GDP) in 1998 onward (when the lagged effects of the 1997 Asian economic crisis was felt) appears to be a surprise at first. Indeed, this external shock may have been very costly to the Vietnamese economy in the sense that a large amount of investment (mainly from overseas) may have been cut so that the GDP loss associated with this cutback would have also been enormous. But the crisis itself was a *positive* factor leading to a slight improvement of total productivity in that it revealed to the government many inherent

problems in the economy and forced it to have necessary, effective policy adjustments (e.g., speeding up the process of restructuring SOEs, devaluating its overvalued currency to boost exports). On the other hand, many ambitious and usually inefficient investment projects have been put on hold or cancelled, and many inefficient firms (mostly SOEs) had to fight for their survival by cutting costs and improving their efficiency. These countermeasures could be among the sources of slight productivity improvement observed in this period. This could also explain why we failed to detect a *negative* (and *significant*) coefficient on the dummy for the Asian crisis (either *D1998*, or *D1999*, or even *D1998-99*) in the preliminary regressions.

Because the conclusion regarding the impact of the Asian financial crisis on the Vietnamese economy contradicts the findings of many studies on Vietnam, some more verification is necessary. Having said that the Asian financial crisis may have adversely affected the level of capital formation in these years, we must be specific that only in 1999 can one observe a sharp drop in the growth rate of capital formation, 1.2 percent compared with 12 percent in 1998 (Table 1). Note further that the rate of 12 percent in 1998 is not very different from the average growth rate in the reform period (14.7 percent in 1987-2003). And even if we assume that the Asian financial crisis was the single factor

behind these decreases,[17] we still cannot state confidently that the crisis's negative impact was as significant as commonly believed by many observers, including the World Bank (cited above). To prove this, let us assume that capital formation would have continued to grow in 1998-99 at the average rate in the sub-period 1987-1997, which was 17.2 percent.[18] Then the loss of GDP due to the cutback of capital formation was from 1.6 percent to 2.5 percent in 1998 and from 3.6 percent to 3.8 percent in 1999 (computed for *K1-K3*). These possible output losses are only a fraction of the World Bank estimate mentioned earlier (11 percent of GDP in 1998). These losses would become even smaller if the above-mentioned small gain in productivity associated with the countermeasures against the regional crisis is taken into consideration.

With regard to the productivity loss of the 1979-80 economic crisis, only the coefficients on *D1980* is significant (Table 6), and the income loss associated with this crisis is from 2.4 percent to 2.5 percent of GDP in this year.

In Table 8, we consider the eight periods, 1975-81, 1981-87, 1987-90, 1990-98, 1998-2003, 1975-86, 1987-2003, and 1975-2003 and show the following decomposition of the GDP growth rate as follows:[19]

Estimated $g_Y = \alpha * g_K + \beta * g_L$ or

$$S = K + L \quad (4)$$

where the *g*'s are the exponential growth rates computed from the cited sources (for GDP and labor) and Table 5 (for capital), and the coefficients on capital and labor are derived from regressions (13)-(15) of Table 6.

[Insert Table 8 here]

As shown in Table 8, the importance of capital to GDP growth increased rapidly and peaked in 1990-98 at an extremely high level, in the range of 92-96 percent. In the next period (1998-2003), though the contribution of capital declined, it was still very high, from 88 percent to 94 percent of GDP growth. In the entire study period, capital contributed between 85 and 92 percent to GDP growth. This figure is between 67 and 82 percent in the pre-reform period (1975-87), and between 90 and 95 percent in the reform period (1987-2003). These imply that the contribution of labor was relatively small in Vietnam and became even smaller in the reform period than in the previous period. Besides the reason that labor force grew at a decreasing rate (Table 1), the modest contribution of labor to GDP growth was also because of the relatively small exponent of labor in the production function (ranging from 0.25 to 0.43, deriving from Table 6), and the exponent of labor shows a downward trend from 1987. The rationale for the low estimates of labor exponents

is that the elasticity of output with respect to labor was low because labor is abundance in the country.[20] It is argued that the ratio of capital to labor will increase and labor will not be in such abundance. However, the fact is that the abundance of labor has persisted in Vietnam after nearly two decades of rapid growth from 1987. This is reflected from the finding on high underemployment and unemployment rates in the country, particularly in rural areas (see, e.g., Haughton et al. (2001)).

5. CONCLUSIONS

In this paper we have estimated different production functions for Vietnam at the aggregate level using official data on real GDP, labor force, and gross capital formation, and assuming different initial values of capital stock. We have showed in this paper that Cobb-Douglas production functions with constant returns and constant capital and labor exponents can explain the data on GDP growth in Vietnam in 1975-2003. The statistics of the estimated production functions have revealed several interesting first-hand information and policy implications concerning the Vietnamese economy that can be summarized as follows:

(1) Capital formation was the major source of economic growth in the country

throughout the study period, particularly in the high growth period of 1990-98. The capital exponent was from 0.57 to 0.75. Capital contributed between 85 and 93 percent to GDP growth in 1975-2003. This share was even higher in the reform period (90-95 percent).

(2) Technological progress was statistically absent in the growth of the Vietnamese economy from 1975 to 2003. The conclusion that there was no significant technological progress, even in the presence of high growth of capital formation as seen in the reform period, may be questioned because official data on capital formation might have been overestimated due to the low depreciation rates employed. Overestimation of capital stock growth would lead to underestimation or even exclusion of technological progress. However, as illustrated in Table 5, even using the three increasing initial values of COR (k_{75}=1, 1.5, 2) that correspond to the three decreasing sets of rates of capital accumulation, we still failed to detect a statistically significant contribution of technological progress to the Vietnamese economic growth.[21]

Further tests for the sensitivity of this conclusion were also conducted using larger initial values of COR (i.e., k_{75}>2).[22] It was shown that the conclusion that technological progress was absent holds until k_{75}>2.8. But this initial value is so large for a developing

country like Vietnam that it becomes almost unpractical, and we can, therefore, confidently exclude this possibility.[23]

Because this conclusion is a major conclusion of this study and reached by a regression analysis using the Cobb-Douglas production function with an exponential trend included, it is imperative to look at the data differently and check the robustness of this conclusion. On the one hand, because of the high correlation between the capital stock and the trend variables, it might be difficult to sort out their relative importance in explaining the growth of GDP in time-series analysis. Nevertheless, our time-series data did eliminate the trend variable as insignificant while maintaining the significance of the capital stock variable. On the other hand, in cross-sectional and panel studies such as Mankiw et al. (1992) and Temple (1998), the capital coefficient is found ranging from 0.56 to 0.66, which is not much different from the one found in this study. It should also be noted that this conclusion is not unique for Vietnam. In the case of China, another transition economy in the region, it is also concluded that the contribution of technological progress to growth for the 1953-1999 was a mere 0.2 percent.

Some other intuitive reasons are also helpful for explaining why technological progress was absent in Vietnam from 1975 to 2003. As reviewed earlier, in the pre-reform period the

government tried to build a Soviet-styled centrally planning, self-sufficient economic system in the country. But it is an accepted fact that such a system has often been associated with inefficiency and lack of incentives for firms to innovate or adopting new technologies from abroad. In addition, the country was isolated from the international community due to its invasion of Cambodia in 1978. Therefore, it is obvious that technological progress was absent in this period in Vietnam.

In the reform period, one may argue that technological progress must have been present in the country given, among other things, a large influx of FDI and export boom that were two main channels inductive to technological innovation. But as pointed out in Phan et al. (2003), which examines the causal relationship between export expansion and long-run growth in Vietnam in 1975-2002, the expected gains of dynamic effects, including accelerated technological progress, from export expansion have been very limited in Vietnam. This is because of problems in, e.g., export structure, trade and industrial policies, linkage between export promotion and industrialization, as well as the inefficient allocation of resources to the export sector.

On the effects of FDI on technological progress, Foster and McCarty (2001) and, especially, Phan (2004), who uses a rich set of foreign project-level data from 1988 to 2001

in his analysis, show that a large portion of FDI was attracted to industries that were heavily protected and/or promoted by tariff and tax policies. Firms operating in these industries were frequently domestic market seekers, internationally uncompetitive, and not exposed to the option of "renovation or death". These are most likely the reasons for the finding in Phan (2004) and Phan and Ramstetter (2004) that foreign firms were not clearly more productive and efficient than local firms in Vietnam in the last decade. It is concluded in this context that the role of FDI in accelerating technological progress is fairly limited.

It is also important to note that SOEs remained significant in many industries until recently, despite the government efforts to restructure and privatize this sector. Phan and Ramstetter (2004) show that SOEs accounted for nearly 40 percent of GDP, 50 percent of industrial sales, and 52 percent of national fixed assets in 2000. More importantly, as pointed out by UNIDO and DSI (1999) and IMF (1999), more than half of SOEs were loss makers because they were badly managed, inefficient, non-productive, and uncompetitive. The existence of most of SOEs relied on government's protection and subsidies in some form. Their existence was, as pointed out by UNIDO and DSI (1999), dragging down the economy. One can, therefore, hardly see where significant technological progress has come from in this situation.

(3) The country relied heavily on foreign funds to finance its capital formation throughout the study period, especially in the pre-reform period. Though this reliance reduced significantly in the reform period, it still stood at a high and warning level (7.3 percent of GDP). More seriously, there is a sign that this reliance has risen again recently. Since the costs of these funds must be repaid some day, the marginal productivity of capital has almost reached its long-term equilibrium, and the economy's efficiency and productivity have not been improved significantly, the continued heavy reliance of the economy on foreign funds will undoubtedly put a break on the growth of income very soon.

(4) Another significant finding is the small exponent for labor in the range of 0.25-0.43, which can be interpreted as resulting from the large supply of labor relatively to capital stock. Because there is no evidence to this point that the elasticity of output with respect to labor has increased substantially, it is implied that labor is still abundant in Vietnam.

(5) Among major internal and external shocks and changes, it is found that only the economic crisis in 1979-80 had a significant impact on output (estimating at around 2.5 percent of GDP in 1980). Unlike many other studies on the negative effects of the 1997 Asian economic crisis, the present study finds that in the period when this crisis was felt, the total productivity was actually *improved* slightly, and the crisis's effect on output loss

due to a capital formation setback seems to have been much more modest than commonly thought. On the other hand, *doi moi* did not have the expected effect on productivity improvement. Its positive effects on income growth may have most obviously come through its creation of a more liberalized framework to attract domestic and foreign investment for development, especially the latter.

We conclude this paper by drawing two other implications regarding Vietnam's growth prospects in the coming decades. First, because of the rapid expansion of the capital base, the relative importance of factor accumulation may be declining (the law of diminishing returns). Furthermore, the potential to further increase factor inputs is limited especially after one considers a decreasing rate of labor force growth and the constraints in natural resources. It is therefore crucial for Vietnam to rely more on productivity growth instead of factor accumulation growth at the present if it is to achieve high and sustainable growth again in the near future.[24]

Second, the rich literature on the successful transition economies, including China as a special case of reference for Vietnam, shows that their productivity growth was largely the result of their increased integration with the global economy and efficiencies gains from market-oriented reforms (see, e.g., Wang and Yao [2003] and references contained therein).

In Vietnam, many of the "easy" reforms have been implemented and some limited initial efficiency gains have been obtained. This means that more painful reforms, especially in the state and banking sectors, will have to be implemented in the next stage of growth.

On the other hand, since Vietnam is expected to become a member of the World Trade Organization (WTO) in 2006, deeper integration with the global economy achieved by proactively fulfilling its obligations committed with the WTO, such as opening the protected domestic industries, will help the country improve further its efficiency and productivity growth through, for example, exposing uncompetitive sectors to foreign competition.

Notes

1. See, for example, Hoa (1997), Luoc (1996), and Binh and Chi (2003), as well as various country reports prepared by such international organizations as the International Monetary Fund, Asian Development Bank, and World Bank.
2. As an illustration, during 1976-1980 heavy industry absorbed nearly 40 percent of state fixed investment while only a half of this share went to agriculture and another much smaller portion to light industry, which produced mainly basic necessities for domestic consumption.
3. For example, peasants were not allowed to own any land and production means. The surplus out of the assigned quantitative output must be sold to the state at unrealistically low prices. As a result, peasants, especially in the South, resisted against collectivization. As such, many of these organizations collapsed right after their establishment, and a large area of arable land was deserted, again most noticeably in the

South.

4. In the sense that the growth trends of outputs of the whole economy and each sector are comparable among these sources.
5. Note that because of the invasion of Cambodia, the country had to confront embargoes from the international community, the result of which was a significant cut in foreign aid and assistance, which were much needed for the country's reconstruction after the war (for more details, see Harvie and Hoa (1997)).
6. It should be emphasized that construction showed a negative growth in 1981-82 but it did not affect the whole economy's growth considerably because its share in GDP was relatively small (slightly higher than 6 percent).
7. More specifically, although the outputs of mining and utilities as well as manufacturing contracted sharply in 1985, the good performance of construction and services, and, in particular, agriculture, a dominant source of GDP generation, which accounted for 42.6 percent of GDP in 1985-86 (Table 3) and was more than twice as large as the combined share of mining and utilities and manufacturing, helped slow down the general deterioration of the whole economy. In contrast, sharp deterioration of agriculture, as well as trade and services in 1986 pulled down the growth of GDP despite the relatively high growth rates of industrial outputs.
8. See Binh and Chi (2003) and Hoa (2000) for an analysis of the channels through which the crisis impact was transferred to the Vietnamese economy.
9. For example, it was reported that by the late 1970s, from 20 to 30 percent of the rice eaten in Vietnam, and most of vital commodities such as petroleum, chemical fertilizer, and transportation system, etc. were being supplied by the Soviet Union (Pike, 1987). See further in Tho (1992), Luoc (1996), and Kimura (1987) for this issue.
10. Not reported in Table 3.
11. If *K1* or *K2* is used, the observed trend is similar.
12. The regression results are not reported here to save place.
13. We use the Eviews 4 software package to conduct all tests and estimations in this section.
14. This dummy takes value of 1 in 1980 and zero otherwise to capture the possible effect of the 1979-80 economic crisis.
15. Marginal productivity of capital and labor are computed from the following equations: (i) marginal productivity of capital = $\alpha Y / K$; (ii) marginal productivity of labor =

$\beta Y / L$.

16. Absorption constraints include underdeveloped institutional arrangements, legal system, and shortage of skillful technical workers and researchers, among many others.
17. This is a rather too strong an assumption, given the many inherent weaknesses in the Vietnamese economy even before the crisis that led to a sharp drop in the growth of investment, in particular, of FDI (see, for example, Kokko (1998) and Freeman (2001)).
18. Based on the United Nation data cited in Table 1.
19. Note that because the coefficient on the trend variable is statistically not different from zero, it is not included in this equation.
20. Theoretically, in the extreme case, excessive surplus labor may yield zero marginal output.
21. More specifically, the growth rates of capital stock were largest with *K1*, second largest with *K2*, and smallest with *K3*. Therefore, the contribution of capital stock to GDP growth was smallest with *K3* and the contribution of technological progress was correspondingly largest. But, as was found, technological progress was absent even with *K3*.
22. Results not reported here.
23. Recall the discussion about this issue in Section 3.
24. It is beyond the scope of this study to discuss measures that enhance productivity growth.

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Table 1: Growth of GDP, labor, and capital formation (1990 constant prices, percent)

Period	Whole economy	Sectoral growth							Expenditure growth		Labor
		Agricul-ture	Mining, utilities	Manufac-turing	Construc-tion	Trade	Services	Other activities	Consumption	Capital formation	
1975	4.4	-	-	-	-	-	-	-	4.4	4.3	2.6
1976	6.3	-	-	-	-	-	-	-	6.3	6.7	2.6
1977	2.0	-	-	-		-	-	-	2.0	1.6	2.5
1978	2.9	-	-	-	-	-	-	-	2.9	2.8	2.5
1979	-1.9	-	-	-		-	-	-	-1.9	-0.5	2.4
1980	-4.8	-	-	-	-	-	-	-	-4.9	-6.4	2.4
1981	4.0	-	-	-		-	-	-	4.1	4.2	2.4
1982	8.7	-	-	-	-	-	-	-	8.8	11.7	2.3
1983	6.3	-	-	-		-	-	-	6.1	0.6	2.2
1984	8.4	-	-	-	-	-	-	-	8.6	11.9	2.3
1985	6.2	9.9	-3.1	-1.1	10.1	0.2	7.9	24.9	6.3	12.8	2.5
1986	2.9	3.0	12.8	12.6	5.8	-2.2	-1.4	-2.5	2.6	-8.2	2.9
1987	4.0	-1.1	11.3	11.6	0.2	3.3	7.8	5.0	4.2	10.7	3.0
1988	5.2	2.0	2.3	1.5	-4.7	33.5	5.7	3.4	4.9	5.8	3.0
1989	4.7	6.8	-3.9	-12.3	3.7	4.1	0.3	7.1	4.3	-10.3	2.9
1990	5.1	1.6	2.5	-5.8	4.7	5.3	4.8	9.3	4.0	45.9	2.7
1991	6.0	2.2	13.7	10.3	5.0	4.8	6.5	6.8	3.6	-8.5	2.2
1992	8.6	7.1	10.2	11.8	11.0	6.1	6.3	10.0	4.2	40.7	2.1
1993	8.1	3.8	12.1	10.4	18.3	6.0	6.5	9.9	4.4	47.2	2.0
1994	8.8	3.9	12.7	10.2	19.4	9.0	7.0	12.8	5.0	14.1	1.9
1995	9.5	4.8	13.9	13.5	12.7	11.1	9.7	8.5	7.3	17.1	1.9
1996	9.3	4.4	13.9	13.6	16.1	9.8	7.4	8.0	8.9	14.2	2.4
1997	8.2	4.3	13.1	12.8	11.3	6.9	8.9	7.0	5.7	9.4	2.1
1998	5.8	3.5	11.3	10.2	-0.5	4.4	3.9	6.0	4.3	12.6	1.9
1999	4.8	5.2	9.3	8.0	2.4	2.1	6.3	1.6	1.8	1.2	1.8
2000	6.8	4.6	10.8	11.7	7.5	5.9	5.8	4.5	3.2	10.1	1.8
2001	6.9	3.0	9.7	11.3	12.8	7.0	6.6	5.0	4.7	10.8	1.8
2002	7.1	4.2	9.2	11.6	10.6	7.2	7.1	5.6	7.4	12.7	1.8
2003	7.3	3.3	10.3	11.5	10.6	6.8	5.5	6.6	7.3	14.0	1.7
Average annual rate of growth in 1975-2003											
	5.7	3.9	7.4	6.6	6.8	5.8	5.2	6.2	4.6	9.8	2.3
Average annual rate of growth in 1975-1986											
	3.7	4.1	3.7	3.9	4.4	2.7	3.5	4.8	3.7	3.2	2.5
Average annual rate of growth in 1987-2003											
	7.2	4.1	9.8	8.2	9.0	8.3	6.3	7.2	5.2	14.7	2.1

Source: Based on data downloaded from http://unstats.un.org/unsd/snaama/SelectionCountry.asp (the United Nations) on Sep 25, 2005.

Table 2: Sectoral Growth and Share in GDP, 1976-1985 (1982 prices, percent)

Year	Growth				Share			
	Agriculture	Industry	Construction	Others	Agriculture	Industry	Construction	Others
1976	-	-	-	-	39.0	39.2	6.9	14.9
1977	-5.6	10.8	0.9	4.8	37.0	41.4	6.7	15.0
1978	-1.9	8.2	-0.4	4.5	35.2	43.4	6.4	15.0
1979	8.7	-4.7	-0.2	-3.3	36.8	42.0	6.5	14.8
1980	6.0	-10.3	-0.5	0.7	39.9	38.5	6.5	15.0
1981	3.5	1.0	-3.0	2.7	40.2	38.4	6.2	15.2
1982	11.3	8.7	-11.3	6.0	41.6	38.4	5.1	14.9
1983	3.3	13.0	13.6	3.7	41.1	39.5	5.3	14.1
1984	5.3	13.2	13.2	15.8	39.1	40.6	5.4	14.8
1985	2.5	9.9	9.9	-0.7	36.0	40.5	6.8	16.7
1986	4.8	6.2	-	-	-	-	-	-

Source: General Statistical Office (1988), Kim (1994).

Table 3: Structure of GDP by Kind of Economic Activity, 1975 and 1985-2002 (1990 VND prices, percent)

Year	Agriculture	Mining, utilities	Manufacturing	Construction	Trade	Services	Other activities
1975	36.5	17.9	13.7	3.7	13.6	3.2	11.4
1985	37.7	16.3	12.8	3.8	12.8	3.2	13.4
1986	37.2	17.6	13.8	3.9	12.0	3.0	12.5
1987	35.2	18.8	14.7	3.7	11.8	3.1	12.6
1988	34.0	18.2	14.1	3.4	15.0	3.1	12.3
1989	35.7	17.2	12.2	3.4	15.3	3.1	13.0
1990	35.4	17.2	11.2	3.5	15.7	3.2	13.8
1991	34.0	18.4	11.6	3.5	15.5	3.2	13.9
1992	33.5	18.7	11.9	3.5	15.2	3.1	14.1
1993	32.2	19.4	12.2	3.9	14.9	3.1	14.3
1994	30.7	20.0	12.3	4.3	14.9	3.0	14.8
1995	29.3	20.8	12.8	4.4	15.1	3.0	14.7
1996	28.0	21.6	13.3	4.6	15.1	2.9	14.5
1997	26.9	22.5	13.8	4.8	14.9	2.9	14.2
1998	26.1	23.5	14.2	4.4	14.6	2.9	14.2
1999	26.1	24.4	14.6	4.3	14.1	2.9	13.7
2000	25.4	25.1	15.2	4.3	13.9	2.8	13.3
2001	24.3	25.7	15.7	4.5	13.9	2.8	13.0
2002	23.6	26.1	16.3	4.7	13.8	2.8	12.8
2003	22.6	26.7	16.9	4.8	13.7	2.8	12.6
Average share in GDP in 1975-2003							
	30.1	21.4	14.0	4.1	14.2	3.0	13.2
Average share in GDP in 1975-1986							
	36.7	17.7	13.6	3.7	13.3	3.2	11.7
Average share in GDP in 1987-2003							
	28.1	22.5	14.2	4.3	14.4	2.9	13.6

Source: As for Table 1.

Table 4: GDP by Type of Expenditure - Percentage Distribution (1990 prices)

Year	Consumption	Gross capital formation	Exports less imports
1975	101.6	12.3	-13.9
1976	101.6	12.3	-13.9
1977	101.5	12.2	-13.8
1978	101.7	12.2	-14.0
1979	101.5	12.4	-13.9
1980	101.5	12.2	-13.7
1981	101.9	12.3	-14.2
1982	101.3	12.5	-13.8
1983	101.5	11.9	-13.3
1984	102.9	12.4	-15.3
1985	100.4	12.8	-13.2
1986	101.5	11.6	-13.2
1987	103.3	12.6	-15.9
1988	100.5	12.3	-12.9
1989	98.8	10.4	-9.2
1990	95.0	14.0	-9.0
1991	92.5	12.1	-4.5
1992	88.0	15.5	-3.5
1993	86.5	21.5	-8.0
1994	85.9	23.2	-9.1
1995	84.0	24.7	-8.7
1996	83.3	25.7	-9.0
1997	81.3	26.0	-7.3
1998	80.3	27.7	-8.0
1999	78.1	26.8	-4.9
2000	75.8	27.7	-3.5
2001	74.9	29.0	-3.9
2002	75.8	30.8	-6.7
2003	75.8	32.7	-8.5
Average share in GDP in 1975-2003	87.3	21.5	-8.8
Average share in GDP in 1975-1986	101.6	12.3	-13.8
Average share in GDP in 1987-2003	83.1	24.2	-7.3

Source: As for Table 1.

Table 5: Estimated Capital Stock Value and Growth (VND billion or percent, 1990 prices)

Year	Value			Growth		
	K1	*K2*	*K3*	*K1*	*K2*	*K3*
1975	23,498,197	35,247,296	46,996,394	-	-	-
1976	26,479,205	38,228,304	49,977,402	12.7	8.5	6.3
1977	29,507,288	41,256,387	53,005,485	11.4	7.9	6.1
1978	32,619,933	44,369,032	56,118,130	10.5	7.5	5.9
1979	35,716,939	47,466,038	59,215,136	9.5	7.0	5.5
1980	38,616,203	50,365,302	62,114,400	8.1	6.1	4.9
1981	41,637,530	53,386,629	65,135,727	7.8	6.0	4.9
1982	45,012,187	56,761,286	68,510,384	8.1	6.3	5.2
1983	48,406,492	60,155,591	71,904,689	7.5	6.0	5.0
1984	52,203,497	63,952,596	75,701,694	7.8	6.3	5.3
1985	56,485,287	68,234,386	79,983,484	8.2	6.7	5.7
1986	60,415,096	72,164,195	83,913,293	7.0	5.8	4.9
1987	64,766,265	76,515,364	88,264,462	7.2	6.0	5.2
1988	69,369,294	81,118,393	92,867,491	7.1	6.0	5.2
1989	73,499,600	85,248,699	96,997,797	6.0	5.1	4.4
1990	79,524,600	91,273,699	103,022,797	8.2	7.1	6.2
1991	85,036,322	96,785,421	108,534,519	6.9	6.0	5.4
1992	92,789,993	104,539,092	116,288,190	9.1	8.0	7.1
1993	104,201,247	115,950,346	127,699,444	12.3	10.9	9.8
1994	117,223,307	128,972,406	140,721,504	12.5	11.2	10.2
1995	132,468,821	144,217,920	155,967,018	13.0	11.8	10.8
1996	149,883,676	161,632,775	173,381,873	13.1	12.1	11.2
1997	168,931,335	180,680,434	192,429,532	12.7	11.8	11.0
1998	190,384,537	202,133,636	213,882,734	12.7	11.9	11.1
1999	212,095,129	223,844,228	235,593,326	11.4	10.7	10.2
2000	236,000,543	247,749,642	259,498,740	11.3	10.7	10.1
2001	262,480,135	274,229,234	285,978,332	11.2	10.7	10.2
2002	292,329,264	304,078,363	315,827,461	11.4	10.9	10.4
2003	326,355,313	338,104,412	349,853,510	11.6	11.2	10.8

Source: As for Table 1.

Note: *K1-K3* represent series of capital stocks constructed based on the initial capital-to-output ratio in 1975 being 1, 1.5, 2, respectively. VND is the Vietnamese currency unit (Vietnamese dong).

Table 6: Cobb-Douglas Production Functions

Regres-sion	Depende variable	*K*	Coefficient on								CRS test (p-	Adj. R-sqr	DW-	F-stat
			Constant	log(*K/L*)	log(*K*)	log(*L*)	*T1*	*T2*	*D1980*	*AR(1)*	*AR(2)*				
1	log(*Y*)	*K1*	-24.520		0.525	-0.187	0.018		-0.026	1.289	-0.525	0.778	0.999	2.136	3,482.28
			(-0.216)		(1.391)	(-0.093)	(0.233)		(-2.577)**	(8.253)***	(-3.631)***				
2	log(*Y/L*)		6.425	0.616			-0.003		-0.025	1.283	-0.523		0.997	2.129	1,735.26
			(0.248)	(3.502)***			(-0.257)		(-2.619)**	(8.562)***	(-3.757)***				
3	log(*Y*)	*K2*	-16.731		0.553	0.318	0.009		-0.025	1.290	-0.556	0.962	0.999	2.155	3,473.63
			(-0.139)		(1.410)	(0.134)	(0.112)		(-2.509)**	(8.469)***	(-3.767)***				
4	log(*Y/L*)		-11.156	0.570			0.005		-0.025	1.289	-0.557		0.997	2.155	1,738.20
			(-0.622)	(3.954)***			(0.599)		(-2.601)**	(8.785)***	(-3.906)***				
5	log(*Y*)	*K3*	-14.113		0.572	0.634	0.005		-0.025	1.294	-0.576	0.945	0.999	2.164	3,447.71
			(-0.116)		(1.429)	(0.245)	(0.059)		(-2.465)*	(8.609)**	(-3.821)**				
6	log(*Y/L*)		-22.464	0.546			0.011		-0.025	1.295	-0.573		0.997	2.162	1,725.03
			(-1.573)	(4.116)**			(1.531)		(-2.586)*	(8.899)**	(-3.978)**				
7	log(*Y*)	*K1*	-1.606		0.345	0.743		0.019	-0.024	1.266	-0.596	0.787	0.999	2.291	3,627.62
			(-0.297)		(1.745)	(1.487)		(1.553)	(-2.508)*	(8.660)**	(-4.076)**				
8	log(*Y/L*)		-0.137	0.402				0.016	-0.025	1.273	-0.588		0.997	2.260	1,810.65
			(-2.113)	(3.690)**				(1.498)	(-2.597)*	(8.934)**	(-4.078)**				
9	log(*Y*)	*K2*	-4.918		0.342	0.934		0.019	-0.024	1.264	-0.620	0.229	0.999	2.331	3,657.26
			(-1.324)		(1.766)	(2.392)*		(1.502)	(-2.489)*	(8.823)**	(-4.332)**				
1	log(*Y/L*)		-0.350	0.569				0.008	-0.025	1.314	-0.622		0.997	2.198	1,723.32
			(-2.927)**	(3.723)**				(0.572)	(-2.601)*	(9.165)**	(-4.263)**				
11	log(*Y*)	*K3*	-7.156		0.340	1.063		0.018	-0.024	1.265	-0.633	0.128	0.999	2.351	3,649.00
			(-2.545)*		(1.746)	(3.261)**		(1.490)	(-2.472)*	(8.906)**	(-4.471)**				
12	log(*Y/L*)		-0.597	0.728				0.002	-0.025	1.390	-0.672		0.997	2.068	1,491.93
			(-2.953)**	(3.390)**				(0.117)	(-2.547)*	(9.393)**	(-4.369)**				
13	log(*Y/L*)	*K1*	-0.239	0.571					-0.026	1.276	-0.510		0.997	2.111	2,263.96
			(-6.942)**	(21.279)**					(-2.675)*	(8.865)**	(-4.116)**				
14	log(*Y/L*)	*K2*	-0.417	0.656					-0.025	1.317	-0.595		0.997	2.162	2,226.34
			(-12.806)*	(26.163)**					(-2.663)*	(9.436)**	(-4.782)**				
15	log(*Y/L*)	*K3*	-0.620	0.753					-0.025	1.392	-0.669		0.997	2.070	1,952.22
			(-15.052)*	(24.648)**					(-2.609)*	(9.728)**	(-4.922)**				

Note: ** and * indicate the 1% and 5% level of significance, respectively. *AR(1)* and *AR(2)* represent the values of serial correlation coefficients under second-order serial correlation process.

Table 7: Marginal Productivity and Percentage Deviations of GDP

Year	Marginal value of product of capital			Marginal value of product of labor			Percentage deviations of GDP		
	K1	*K2*	*K3*	*K1*	*K2*	*K3*	*K1*	*K2*	*K3*
1975	0.571	0.438	0.376	0.439	0.351	0.253	-22.0	-14.7	-9.9
1976	0.539	0.429	0.376	0.455	0.364	0.262	-2.6	5.5	11.6
1977	0.493	0.405	0.362	0.452	0.362	0.261	-6.7	-1.8	1.8
1978	0.459	0.388	0.352	0.454	0.364	0.262	-8.1	-4.5	-2.0
1979	0.411	0.356	0.327	0.435	0.348	0.251	-2.3	0.9	3.0
1980	0.362	0.319	0.297	0.405	0.324	0.233	-2.5	-0.1	1.2
1981	0.349	0.313	0.294	0.411	0.329	0.237	6.7	9.3	10.8
1982	0.351	0.320	0.304	0.437	0.350	0.252	-11.5	-10.4	-10.4
1983	0.347	0.321	0.308	0.454	0.364	0.262	-2.8	-1.0	-0.2
1984	0.349	0.328	0.317	0.481	0.385	0.277	-5.5	-4.4	-4.2
1985	0.342	0.326	0.319	0.498	0.399	0.287	-2.7	-2.0	-2.0
1986	0.330	0.317	0.313	0.499	0.399	0.287	-1.1	-1.1	-1.6
1987	0.320	0.311	0.309	0.503	0.403	0.290	-2.6	-3.1	-4.1
1988	0.314	0.309	0.309	0.514	0.411	0.296	-2.9	-3.5	-4.7
1989	0.310	0.307	0.310	0.523	0.419	0.301	-2.2	-3.1	-4.5
1990	0.301	0.302	0.306	0.535	0.428	0.309	-1.3	-2.4	-4.0
1991	0.298	0.302	0.308	0.555	0.444	0.320	-2.9	-4.1	-5.9
1992	0.297	0.303	0.313	0.591	0.473	0.341	-3.4	-4.7	-6.3
1993	0.286	0.296	0.308	0.626	0.501	0.361	-0.8	-2.1	-3.6
1994	0.277	0.289	0.304	0.668	0.535	0.385	-1.9	-3.4	-4.9
1995	0.268	0.283	0.300	0.718	0.575	0.414	-1.7	-3.0	-4.2
1996	0.259	0.276	0.295	0.767	0.614	0.442	-0.8	-1.9	-2.9
1997	0.249	0.267	0.288	0.813	0.651	0.469	0.0	-0.9	-1.6
1998	0.233	0.253	0.274	0.843	0.675	0.486	2.2	1.6	1.3
1999	0.219	0.239	0.261	0.868	0.695	0.500	2.4	2.0	1.9
2000	0.211	0.231	0.253	0.910	0.728	0.524	1.2	1.3	1.6
2001	0.202	0.223	0.245	0.955	0.765	0.551	2.6	3.4	4.3
2002	0.195	0.215	0.238	1.005	0.805	0.579	3.1	4.3	5.8
2003	0.187	0.208	0.230	1.060	0.849	0.611	3.6	5.4	7.5

Note: Marginal productivity is measured in VND/VND a year (capital) and VND million/person a year (labor), using 1990 VND prices.

Table 8: Sources of and Contribution to GDP Growth for Various Sample Periods

Regression number (from Table 6)	Sample period	Sources of growth (exponential rates			Contribution to growth (%)	
		K	*L*	*S*	*K*	*L*
13	1975-81	0.0075	0.0106	0.0180	41.3	58.7
	1981-87	0.0308	0.0105	0.0413	74.5	25.5
	1987-90	0.0644	0.0124	0.0767	83.9	16.1
	1990-98	0.0982	0.0089	0.1071	91.7	8.3
	1998-03	0.0552	0.0077	0.0628	87.8	12.2
	1975-87	0.0214	0.0107	0.0322	66.6	33.4
	1987-03	0.0783	0.0091	0.0874	89.6	10.4
	1975-03	0.0533	0.0098	0.0631	84.5	15.5
14	1975-81	0.0086	0.0085	0.0171	50.3	49.7
	1981-87	0.0354	0.0084	0.0439	80.8	19.2
	1987-90	0.0740	0.0099	0.0839	88.2	11.8
	1990-98	0.1129	0.0071	0.1200	94.1	5.9
	1998-03	0.0634	0.0061	0.0696	91.2	8.8
	1975-87	0.0247	0.0086	0.0333	74.1	25.9
	1987-03	0.0900	0.0073	0.0973	92.5	7.5
	1975-03	0.0613	0.0079	0.0691	88.6	11.4
15	1975-81	0.0098	0.0061	0.0159	61.7	38.3
	1981-87	0.0406	0.0061	0.0467	87.0	13.0
	1987-90	0.0849	0.0071	0.0920	92.2	7.8
	1990-98	0.1295	0.0051	0.1346	96.2	3.8
	1998-03	0.0727	0.0044	0.0772	94.3	5.7
	1975-87	0.0283	0.0062	0.0345	82.0	18.0
	1987-03	0.1032	0.0053	0.1085	95.2	4.8
	1975-03	0.0703	0.0057	0.0759	92.6	7.4

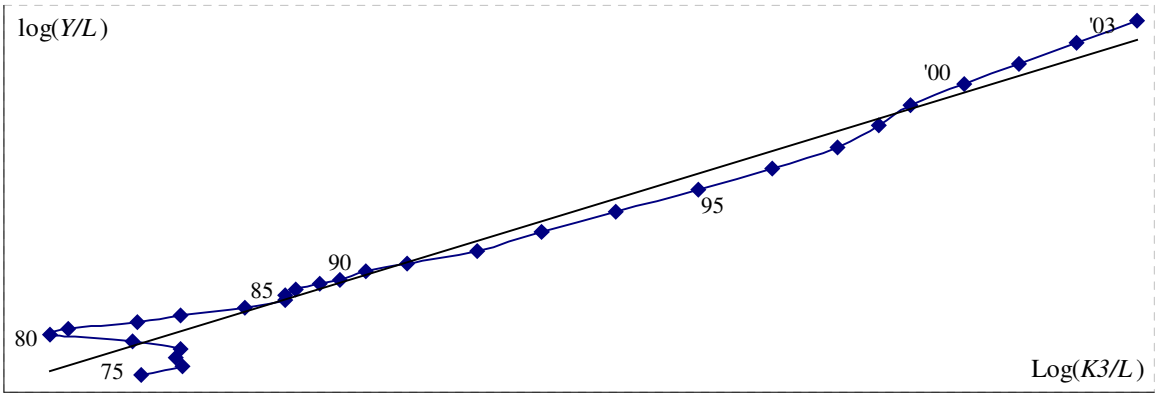
Note: K = capital; L = labor; S = sum of estimates.

Appendix Table 1: Assigned Values for Dummy and Trend Variables Used in Production Fucntions

Year	*T1*	*T2*	*D1979-80*	*D1980*	*D1986*	*D1989*	*D1998*	*D1999*	*D1998-99*	*DM*
1975	1	0	0	0	0	0	0	0	0	0
1976	2	0	0	0	0	0	0	0	0	0
1977	3	0	0	0	0	0	0	0	0	0
1978	4	0	0	0	0	0	0	0	0	0
1979	5	0	1	0	0	0	0	0	0	0
1980	6	0	1	1	0	0	0	0	0	0
1981	7	0	0	0	0	0	0	0	0	0
1982	8	0	0	0	0	0	0	0	0	0
1983	9	0	0	0	0	0	0	0	0	0
1984	10	0	0	0	0	0	0	0	0	0
1985	11	0	0	0	0	0	0	0	0	0
1986	12	0	0	0	1	0	0	0	0	0
1987	13	0	0	0	0	0	0	0	0	0
1988	14	0	0	0	0	0	0	0	0	0
1989	15	1	0	0	0	1	0	0	0	1
1990	16	2	0	0	0	0	0	0	0	1
1991	17	3	0	0	0	0	0	0	0	1
1992	18	4	0	0	0	0	0	0	0	1
1993	19	5	0	0	0	0	0	0	0	1
1994	20	6	0	0	0	0	0	0	0	1
1995	21	7	0	0	0	0	0	0	0	1
1996	22	8	0	0	0	0	0	0	0	1
1997	23	9	0	0	0	0	0	0	0	1
1998	24	10	0	0	0	0	1	0	1	1
1999	25	11	0	0	0	0	0	1	1	1
2000	26	12	0	0	0	0	0	0	0	1
2001	27	13	0	0	0	0	0	0	0	1
2002	28	14	0	0	0	0	0	0	0	1
2003	29	15	0	0	0	0	0	0	0	1

Note: *T1* and *T2* are trend variables; *D* is a dummy variable to control for the effect of a major shock (the figure that follows is the year or period to be controlled for); *DM* is a dummy for *doi moi.*

Figure 1: Capital Stock and Total Productivity, 1975-2003



Source: As for Table 1.

Note: *Y*, *K3,* and *L* represent for GDP, capital stock (with the COR in 1975 = 2), and labor force, respectively.

Captions

Figure 1: Capital Stock and Total Productivity, 1975-2003

Source: As for Table 1.

Note: *Y*, *K3,* and *L* represent for GDP, capital stock (with the COR in 1975 = 2), and labor force, respectively.

Table 1: Growth of GDP, labor, and capital formation (1990 constant prices, percent)
Source: Based on data downloaded from http://unstats.un.org/unsd/snaama/SelectionCountry.asp (the United Nations) on Sep 25, 2005.

Table 2: Sectoral Growth and Share in GDP, 1976-1985 (1982 prices, percent)
Source: General Statistical Office (1988), Kim (1994).

Table 3: Structure of GDP by Kind of Economic Activity, 1975 and 1985-2002 (1990 VND prices, percent)
Source: As for Table 1.

Table 4: GDP by Type of Expenditure - Percentage Distribution (1990 prices)
Source: As for Table 1.

Table 5: Estimated Capital Stock Value and Growth (VND billion or percent, 1990 prices)
Source: As for Table 1.
Note: *K1-K3* represent series of capital stocks constructed based on the initial capital-to-output ratio in 1975 being 1, 1.5, 2, respectively. VND is the Vietnamese currency unit (Vietnamese dong).

Table 6: Cobb-Douglas Production Functions
Note: ** and * indicate the 1% and 5% level of significance, respectively. *AR(1)* and *AR(2)* represent the values of serial correlation coefficients under second-order serial correlation

process.

Table 7: Marginal Productivity and Percentage Deviations of GDP

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Note: *T1* and *T2* are trend variables; *D* is a dummy variable to control for the effect of a major shock (the figure that follows is the year or period to be controlled for); *DM* is a dummy for *doi moi.*