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Growth and Structural Change in the Vietnamese Economy 1996-2003: A CGE Analysis

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Growth and structural change

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Tran Hoang Nhi* and James A. Giesecke

Abstract

We use MVN – a dynamic CGE model of the Vietnamese economy – to investigate the Vietnamese economy's rapid growth and structural change over the period 1996 to 2003. We do this in two steps. First, we estimate changes in variables representing production technologies, consumer preferences, government policy and other structural features of the economy. Movements in these structural and policy variables are then used to explain the recent history of Vietnam's rapid growth and structural change. We find the most important sources of growth and change to be technical improvements, favourable shifts in foreign preferences for Vietnamese goods and employment growth. Other important factors include movement in household preferences away from primary products and towards manufactures and services, expansion in agricultural land supply, and tax reform.

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1. INTRODUCTION

In the two decades since it began market-oriented reforms, Vietnam has experienced rapid growth and substantial structural change. Naturally, Vietnam's remarkable economic performance has stimulated commentary on the observable features of Vietnam's economic success (such as rapid growth in real GDP, export diversification, and changes in industrial structure) and research into the causes of these outcomes (such as private sector development, state enterprise reform, and natural resource supply). Our paper also investigates the observable features of Vietnam's recent economic history. We explain this history as the net effect of a large number of structural, policy and international shocks.

To date, much of the research into the recent history of Vietnam's economic growth and structural change has been of a detailed qualitative nature (see, for example Kokko 1998, Fforde 2001, Van Arkadie and Mallon 2003, Dapice 2003). This research has discussed key features of Vietnam's recent economic outcomes, such as the rapid growth in, and increased diversity of exports[1]; rapid GDP growth[2]; industrial growth[3]; macroeconomic stability[4]; private investment growth[5]; resilience to external shocks[6]; private sector growth[7]; and growth and change in private consumption[8]. These outcomes have been attributed to such causes as market-oriented reforms in the areas of state-owned enterprises, private sector development and agriculture[9]; the stability of social and political institutions[10]; macroeconomic stability[11]; proximity to other rapidly growing Asian economies[12]; export growth and diversification[13]; foreign direct investment[14]; and external assistance[15].

There have been only a few quantitative investigations of Vietnam's recent economic success. Le Thanh Nghiep and L.H. Quy (2000), Tran Tho Dat (2004) and Le Viet Anh (2006) use the Solow (1957) growth accounting framework to decompose changes in GDP into changes in factor inputs and total factor productivity. Pham Quang Ngoc et al. (2006) use a multi-sectoral dynamic input-output model to decompose changes in sectoral output and value added into contributions by shifts in various demand-side variables.

Our paper is also of the quantitative kind. We use a multi-sectoral dynamic CGE model to investigate the causes of Vietnam's recent economic performance. Our CGE model allows us to impose neoclassical economic structure on this research question. Such structure allows us to carefully distinguish causes and effects. For example, in our neoclassical framework, rapid growth in exports and changes in export structure are largely endogenous. Hence, they cannot be causes of Vietnam's economic success, as has been suggested in some previous studies. We explain export growth and change in terms of shifts in both domestic factors (such as changes in technology, tastes and policy) and foreign factors (such as changes in foreign demands and import prices). In addition to neoclassical structure, our model is also very detailed. This allows us to explain a wide range of economic outcomes in terms of a large number of structural, policy and external shocks. For example, like some previous quantitative studies of Vietnam's economy, one output of our model is the contribution of TFP growth to real GDP. However, we do not produce a single TFP estimate. We are able to decompose TFP's contribution to real GDP into contributions made by a large number of sector-specific technical change variables. We can also evaluate the impact on real GDP of a large number of variables that are not part of the standard growth-accounting framework, such as movements in taxes and

household tastes. Moreover, our decomposition technique allows us to explain observed economic outcomes for a far wider range of variables than just real GDP.

Table 1 introduces our findings, presenting a highly condensed summary of our results. In Table 1, recent outcomes for six macroeconomic variables and three sectoral variables are attributed to domestic structural changes, changes in domestic factor supplies, foreign factors, and domestic policy change. For example, over the study period 1996-2003, Vietnamese real GDP (row 1) grew by 58.3 per cent (column 5). We find that 27.3 percentage points, or just under half of GDP's real growth, was due to domestic structural changes (column 1). The columns of Table 1 aggregate our more detailed findings, allowing us to highlight five major themes of Vietnam's recent economic development:

(a) Much of the rapid growth in Vietnamese real GDP was due to domestic structural changes. We conjecture that productivity-enhancing structural changes in column 1 are due in some part to the growth-enabling effects of *Doi Moi* liberalisation policies. Growth in domestic factor supplies (column 2) and favourable shifts in international trading conditions (column 3) also contributed to real GDP growth. The domestic policy changes summarised in column 4 had little effect on growth.

(b) Domestic structural change not only caused dramatic growth in the *level* of Vietnamese economic activity, but also dramatically changed its *composition*. In Column 1, we see that structural change shifted the composition of economic activity towards trade and investment (the expansions in investment, exports and imports are far higher than real GDP growth) and away from consumption. Domestic structural changes favoured growth in manufacturing (row 8, column 1) relative to agriculture and services (rows 7 and 9, column 1).

(c) The strong growth of trade was also the results of changes in foreign structural factors and domestic policies that reduce barriers to trade (rows 5 and 6, columns 3 and 4).

(d) Real private consumption spending grew rapidly (column 5, row 2). Much of the real consumption gain was attributable to favourable outcomes in the international markets in which Vietnam sells exports and buys imports (column 3, row 2).

(e) The study period coincided with a substantial increase in usage of land and water resources in agriculture. This accounted for a sizeable proportion of agriculture's expansion (row 7, column 2).

We expand on these themes in Section 3, where we discuss the simulation results in detail.

Table 1: Summary decomposition of macroeconomic and sectoral outcomes, 1996-2003

	1. Domestic structural change (DS)	2. Domestic factor supply (DF)	3. Foreign structural factors (F)	4. Domestic policy change (DP)	5. Total	6. Annual average
Main macro indicators						
1. Real GDP	27.3	11.5	14.9	4.6	58.3	6.8
2. Real private consumption	8.4	9.6	30.6	-1.6	47	5.7
3. Real public consumption	7.6	9.1	28.9	-13.2	32.4	4.1
4. Real investment	40.5	11.4	32.7	15.5	100.2	10.4
5. Real exports	86.3	16.5	21.1	20.9	144.8	13.6
6. Real imports	55.5	11.8	54.9	11.7	133.9	12.9
Changes in output of						
7. Agriculture	32.5	22.5	0.1	-0.5	54.6	6.4
8. Mining, Manufacturing and Construction	55.8	10.5	20.9	10.3	97.5	10.2
9. Services	29.3	9.6	21	3	62.9	7.2

Notes: This table aggregates (by column) results reported in Tables 4 and 5.

Domestic structural changes (DS) is comprised of shifts in: technical efficiency, household tastes, import/domestic preferences, investment/capital ratios and the average propensity to consume. The columns reporting the individual impacts of these effects are marked DS in Table 4.

Domestic factor supply (DF) is comprised of growth in employment and land. The columns reporting the individual impacts of these factors are marked DF in Table 4.

Foreign factors (F) is comprised of: shifts in international trade conditions; changes in foreign grants and transfers and changes in foreign liabilities. The columns reporting the individual impacts of these factors are marked F in Table 4.

Domestic policy change (DP) is comprised of: introduction of VAT and reforms in indirect taxes; trade tax reforms; change in the public/private consumption ratio; changes in the composition of public consumption; and excess foreign borrowing. The columns reporting the individual impacts of these factors are marked DP in Table 4.

The remainder of this paper is structured as follows. Section 2 provides overviews of MVN and the closures used in historical and decomposition simulations. Both simulations incorporate a lot of detail, and MVN is too large to document fully in a paper this size. To summarise this detail, section 2 presents a simple "back-of-the-envelope" (BOTE) model. The focus of this paper is the decomposition simulation. Hence BOTE is designed to illustrate the major MVN mechanisms operating in this simulation. Section 3 discusses the results of the decomposition simulation. This discussion relies heavily on BOTE. However BOTE only includes relationships between macroeconomic variables. Understanding some aspects of the decomposition simulation requires elucidation of MVN's sectoral detail. At other times, reference to some feature of the historical simulation is useful. Hence, as required, additional stylised equations are introduced to the explanations in Section 3. Section 4 concludes the paper.

2. METHOD

1. Overview of MVN

MVN is a dynamic CGE model of the Vietnamese economy. Its theoretical structure is based on the MONASH model (Dixon and Rimmer 2002). The model captures the structure and characteristics of the Vietnamese economy via calibration to 1996 Vietnamese input-output data[16], choice of elasticities[17], and the representation of features which are pertinent to the Vietnamese economy, such as particular types of taxes, transfers and transactions with the rest of the world.

MVN has 93 industries, each of which uniquely produces one of 93 commodities[18]. It has three primary factors: labour, capital and land. Labour, in turn, is distinguished by unskilled, semi-skilled, and highly-skilled. Investment decisions are modelled for each of the 93 industries. There is one representative household, and one central government.

Decision-making by firms and households is governed by optimising behaviour. Each representative industry is assumed to minimise unit costs subject to constant returns to scale production technologies and given input prices. Household commodity demands are modelled via a representative utility-maximising household. Units of new industry-specific capital are assumed to be cost minimising combinations of commodities sourced from Vietnam and overseas. Imperfect substitutability between imported and domestic varieties of each commodity is modelled using the CES assumption of Armington. The export demand for any given Vietnamese commodity is assumed to be inversely related to its foreign-currency export price. The model recognises both the consumption of commodities by government, and a variety of direct and indirect taxation instruments. In general, markets are assumed to clear and to be competitive. Purchasers' prices differ from producer prices by the value of indirect taxes and margin services. The model is solved with the GEMPACK economic modelling software (Harrison and Pearson, 1996).

2. A stylised version of MVN – the BOTE model

Equations (E1) – (E12) in Table 2 describe a stylised representation of the MVN model[19]. Hereafter we refer to this as the "back-of-the-envelope" or BOTE model. Table 2 presents the BOTE model under two closures: decomposition and historical. We explain the equations of BOTE, before turning to a discussion of these two closures.

BOTE assumes a single domestically produced good that is used domestically and exported, and a single imported good. Equation (E1) describes the GDP (Y) identity in constant price terms. Equation (E2) describes an economy-wide CRS production function, relating Y to inputs of labour, capital and land (L, K and Lnd) and primary factor augmenting technical change (A). (E3) links total consumption (C+G) to real GNP via a given propensity to consume out of GNP (APC). Equation (E4) defines Γ, the ratio of real private (C) to real public (G) consumption spending. (E5) defines real GNP as real GDP multiplied by a positive function of the terms of trade (TOT) less interest payments on net foreign liabilities ($NFL \cdot R$, where NFL is real (consumption price deflated) net foreign liabilities and R is the interest rate)[20]. Equation (E6) summarises the determination of import volumes (M). In MVN, demands for imports are related to: activity by each agent (represented in E6 by Y); import/domestic preference terms (represented in E6 by T); tariff rates, T_M; and, the ratio of domestic to import prices (proxied in E6 by the terms of trade, TOT). Demand for imports also respond in MVN to changes in household preference and industry technology variables, represented in (E6) by A_C. Changes in these variables can affect imports by moving demand towards or away from commodities for which imports occupy a major share of the domestic market. Commodity exports in MVN are inversely related to their foreign currency prices via constant elasticity demand functions. This is summarised by (E7), which relates the foreign currency price of exports (P_X) to the volume of exports (X) (movements along foreign demand schedules), export tax rates T_X, and a shift variable V (shifts in foreign demand schedules). Long-run industry-specific

investment / capital ratios are assumed in MVN to be a reflection of business confidence, and hence are exogenous. In BOTE this is represented by (E8), which defines the aggregate investment / capital ratio (Ψ). Like MVN the BOTE model assumes CRS. Hence marginal product functions are homogeneous of degree 0 and so can be expressed as functions of K/L and A. This accounts for (E9) and (E10). Equation (E9) relates the profit maximising capital / labour ratio to the post tax rate of return on capital (ROR), the tax rate on capital income (T_K), technological change (A), tax on inputs to capital construction (T_I), and the terms of trade (TOT)[21]. Cost-neutral labour/capital bias in technical change is described by Ξ. (E10) relates the real consumer wage (W) to changes in the capital / labour ratio, technology, and the terms of trade[22]. MVN relates the change in NFL to the accumulated savings / investment imbalance over the simulation period. This is represented by (E11)[23]. (E12) defines the terms of trade as the ratio of foreign currency export prices to import prices (P_M).

Table 2: The BOTE model and its decomposition and historical closures

	A. Decomposition closure	**B. Historical closure**
(E1)	$Y=C + I + G + X - M$	$Y=\mathbf{C} + \mathbf{I} + \mathbf{G} + \mathbf{X} - \mathbf{M}$
(E2)	$Y=\mathbf{A}.F_1(K, \mathbf{L}, \mathbf{Lnd})$	$Y=A.F_1(\mathbf{K}, \mathbf{L}, \mathbf{Lnd})$
(E3)	$C + G = \mathbf{APC}$. GNP	$\mathbf{C} + \mathbf{G}$ = APC . GNP
(E4)	$C / G = \mathbf{\Gamma}$	$\mathbf{C} / \mathbf{G} = \Gamma$
(E5)	$GNP=Y.F_2(TOT) - NFL.\mathbf{R}$	$GNP=Y.F_2(TOT) - NFL.\mathbf{R}$
(E6)	$M=F_3(Y, TOT, \mathbf{T_M}, \mathbf{T}, \mathbf{A_C})$	$\mathbf{M}=F_3(Y, TOT, \mathbf{T_M}, T, \mathbf{A_C})$
(E7)	$P_X=F_4(X, \mathbf{T_X}, \mathbf{V})$	$\mathbf{P_X}=F_4(\mathbf{X}, \mathbf{T_X}, V)$
(E8)	$\mathbf{\Psi}= I / K$	$\Psi = \mathbf{I} / \mathbf{K}$
(E9)	$K/\mathbf{L}=F_5(\mathbf{ROR}, \mathbf{T_K}, \mathbf{T_I}, \mathbf{A}, TOT, \mathbf{\Xi})$	$\mathbf{K} / \mathbf{L}=F_5(\mathbf{ROR}, \mathbf{T_K}, \mathbf{T_I}, A, TOT, \Xi)$
(E10)	$W=F_6(K/\mathbf{L}, \mathbf{A}, TOT)$	$W=F_6(\mathbf{K} / \mathbf{L}, A, TOT)$
(E11)	$NFL=F_7(K, \mathbf{APC}, GNP)$	$NFL=F_7(\mathbf{K}, APC, GNP)$
(E12)	$TOT=P_X / \mathbf{P_M}$	$TOT=\mathbf{P_X} / \mathbf{P_M}$

Bold denotes exogenous. Remaining variables are endogenous.

3. Closures of the MVN model

This section uses BOTE to describe the main features of the MVN historical and decomposition simulations[24]. The aim of these simulations is to explain economic history. To do this, economic history must first be imposed on the model. In terms of the BOTE model, economic history consists of Vietnam Statistics Office reports for variables such as Y, C, I, G, X, M, K, and L. Notice however that under a typical closure of the model, most of these variables are endogenous. The MVN decomposition closure is such a "typical"

closure. Using BOTE to describe the MVN decomposition closure, Y, C, I, G, X, M, K, P_X, TOT, W, GNP and NFL, would be determined endogenously, given user-specified values for L, Lnd, ROR, A, Ξ, Ψ, V, T, Γ, APC, P_M, A_C, T_K, T_I, T_X, T_M and R. For ease of reference, we represent the BOTE decomposition closure in panel A of Table 2 by rendering exogenous variables in bold. Under the decomposition closure, each BOTE equation can be readily associated with the determination of a specific endogenous variable. For a given TOT, (E9) largely determines K. This fixes I and Y via (E8) and (E2) respectively. With Y determined, so too is much of GNP via (E5). With GNP and K determined, so too are savings and investment, allowing (E11) to determine NFL. C and G are determined by (E3) and (E4). (E6) determines M leaving (E1) to determine X. (E7) determines P_X and (E12) determines TOT. (E10) determines W. Linkages like these will be used in Section 3 to explain the results of the decomposition simulation.

Under the decomposition closure, most of the variables describing economic history are endogenous. Hence their values cannot be imposed on the model. A new closure must be developed (the historical closure) in which variables describing economic history are exogenous. As Dixon and Rimmer (2002) explain, the historical closure is best described by showing its development in a stepwise fashion from an initial decomposition closure. At each step, a variable describing an observable feature of economic history is moved to the set of exogenous variables via the endogenous determination of an appropriate variable describing a feature of the economy's structure. In terms of BOTE: C is swapped with APC; G is swapped with Γ; I is swapped with Ψ; M is swapped with T; P_X is swapped with V; X is swapped with A; and K is swapped with Ξ. The set of exogenous variables is now C, G, I, M, X, P_X, K, L, Lnd, ROR, A_C, T_K, T_M, T_X, R, P_M and T_I, leaving the model to determine APC, Γ, Ψ,T, A, V, Ξ, Y, W, TOT, GNP and NFL. In terms of BOTE, the historical simulation imposes the historical values for C, G, I, M, X, P_X, P_M, K, L, Lnd, ROR, T_K and T_I on the model. Given these shocks, and the model's theory and data, the model calculates the historical movements in variables describing economic structure, namely APC, Γ, Ψ, T, V, A, Ξ.

The decomposition simulation takes the historical simulation results for APC, Γ, Ψ, T, V, A, Ξ, along with the historical simulation shocks to L, Lnd, P_M, ROR, T_K, T_X and T_I, and imposes them on the model under the decomposition closure. The decomposition simulation reproduces the historical simulation values for C, G, I, M, X, Y, TOT, P_X, W and K. More importantly, it allows the movements in these variables to be decomposed into the individual contributions of the shocks to APC, Γ, Ψ, T, V, A, Ξ, L, Lnd, P_M, ROR, T_K, T_X and T_I, that is, it allows an explanation of economic history in terms of movements in variables describing economic structure and policy.

The preceding explanation of the historical and decomposition closures, relying as it does on the stylised BOTE model, has emphasised macroeconomic relationships only. However the MVN simulation discussed in Section 3 involves far more detail. This detail is described in Table 3. For example, consider the first row of panels A and B. In the MVN historical simulation, real consumption by commodity (row 1, panel A) is determined exogenously at historically observed values. This effectively determines aggregate consumption (in terms of BOTE, C) requiring that the average propensity to consume (in terms of BOTE, APC) be endogenous (row 1, panel B). However, since it is consumption by commodity that is exogenous, additional freedom in the form of endogenous shifts in household preferences (row 1, panel B) are also required. In a paper of this size, it is not

possible to fully describe the closure swaps of Table 3. Readers are referred to Dixon and Rimmer (2002) for details.

Table 3. Status of some variables under the historical and decomposition closures

A. Variables endogenous under decomposition closure, exogenous and shocked in historical closure	**B. Corresponding variables which are exogenous under decomposition closure, endogenous in historical closure**
• Consumption by commodity • Import volumes by commodity • Export volumes by commodity • Investment by industry • Aggregate capital stock • Employment by industry • Outputs of commodities • Export prices, by commodity • Consumer prices, by commodity	• *Consumer preferences by commodity, APC* • *Import/domestic preference shifts by commodity* • *Shifts in export demand schedules by commodity* • *investment/capital ratios by industry* • *Aggregate labour/capital bias in technical change* • *Primary factor technical change by industry* • *Intermediate-input-technical change* • *Supply (mark-up) shifts by commodity* • *Supply (mark-up) shifts by commodity*
Shocked variables which are exogenous in both historical and decomposition closure	
• Consumer price index • Number of households and population • c.i.f. import prices in foreign currency • Government consumption by commodity • Tariff rates, value-added tax rates, export tax rates • Land use by industry	
Variables which are endogenous in both historical and decomposition closure	
• Demand for source-specific commodity inputs by industry, for current production • Demand for source-specific commodity inputs by industry, for capital creation • Prices of source-specific commodity inputs by industry, for current production • Prices of source-specific commodity inputs by industry, for capital creation • Demand for margin *m* by agent *k* to facilitate purchase of commodity *c* from source *s*	

(Source: Adapted from Dixon et al. 2000)

3. RESULTS OF THE DECOMPOSITION SIMULATION

The historical simulation revealed major changes in variables describing structural and policy features of the Vietnamese economy. Among the most important were productivity improvements, improvements in the international environment for Vietnamese exports, population and employment growth, additional land supply, and an apparent rise in investor confidence. Household preferences moved toward manufacturing goods and away from primary products. At the macro level, the rate of savings out of GNP increased, while the share of public consumption in total consumption fell.

To evaluate the contributions of these and many other policy changes on the economy, we use the algorithm of Harrison, Horridge and Pearson (2000) to run the decomposition simulation, where all the variables associated with those changes are exogenous and shocked with the values revealed in the historical simulation. For example, all variables in panel A, Table 3, are now exogenous, and all variables in panel B are endogenous.

Tables 4 and 5 report the results of the decomposition simulation. The historical movements in key endogenous variables are reported in column 10, and their annual averages are reported in column 11. More detail results from the historical simulation for changes in technology, preferences and other structural variables will be reported briefly in the relevant columns. Overall, more than a thousand MVN variables are shocked in this simulation, so reporting results necessarily requires some summarisation. This is achieved by aggregating the individual effects of each of the exogenous shocks within 9 sets of related variables. These sets correspond to the first 9 columns of Tables 4 and 5. The results in any given column can be interpreted as the impact of the historical movement of the exogenous variable in question (e.g. technical change in column 1) in isolation of the exogenous structural and policy shocks represented by the other columns[25]. The results in any given row show the individual contributions of the 9 exogenous factors to the historical movement of the endogenous variable in question (egg real GDP for row 1). This allows explanations of economic outcomes in terms of contributions by structural and policy shocks. For example, the strong growth in real GDP (row 1) was due largely to productivity growth (column 1) and favourable international trading environment (column 2). However, shifts in foreign demands and changes in trade prices are found to have the largest contribution to the growth in capital stocks. In Tables 4 and 5, the groups of exogenous variables are arranged approximately in descending order of their importance to the growth of real GDP in the economy during the study period. The remainder of this section interprets the results in Tables 4 and 5, proceeding column by column.

1. Technical change (column 1)

In BOTE, input-using technical change is represented simply by A. However in MVN, technology is modelled in detail. In particular, in the MVN historical simulation, we determine the following technology variables endogenously[26]:

(i) primary factor saving technical change, by industry;
(ii) commodity-specific input requirements for current production and capital formation;
(iii) all-input-using technical change in current production, by industry;
(iv) all-input-using technical change in capital formation, by industry; and
(v) economy-wide labour/capital bias in technical change.

In the decomposition simulation, these variables are exogenous and shocked equal to their historical simulation values. Column 1 of Table 4 reports the aggregate impact of these technical changes on the Vietnamese economy, in isolation of the effects of other exogenous economic shocks over 1996-2003.

The historical simulation revealed that most sectors experienced improvements in input-using technical efficiency. In aggregate, these changes in industry- and commodity-specific technology variables represented a rise in total factor productivity of just under 15 per cent, accounting for much of the rise in real GDP at factor cost (row 2)[27].

The macroeconomic effects of the rise in economy-wide productivity can be traced with BOTE under the decomposition closure (Table 2, column A). Higher productivity is represented by a rise in A. With employment and rates of return given, higher A raises the capital stock (via E9), real wages (via E10), and real GDP (via E2). *Ceteris paribus*, the rise in GDP causes real GNP to be higher (via E5). However, the additional domestic savings generated by the rise in real GNP are not sufficient to fund the additional

investment required to generate the higher capital stock given by (E9). This accounts for the rise in NFL as a proportion of GNP (row 18). With A contributing strongly to the rise in Y, the growth in K must be less than the growth in Y. Hence so too is the increase in I (via E8). Private and public consumption grow with GNP via (E3). With I growing by less than real GDP, GNE growth (row 3) is less than real GDP growth (row 1). This accounts for part of the movement of the real balance of trade towards surplus (compare rows 8 and 9). As we explain below, commodity- and industry-specific details of the technical changes were such as to strongly favour trade. The resulting expansion in export volumes reduced the terms of trade (row 16) requiring additional export expansion to finance a given quantity of imports. This widened the gap between the outcome for real exports (row 8) and real imports (row 9). To open this gap, the price of imports must rise relative to the price of domestic goods. This accounts for the strong real depreciation (row 15, column 1).

Technical change was strongly trade-promoting. In column 1, we see that technical change caused GDP to grow by 23.2 per cent, while causing imports and exports to expand by 46.3 and 62.8 per cent respectively (rows 9 and 8). Technical change was trade-promoting for two reasons. Firstly, productivity growth was relatively high in export-oriented industries, particularly mining. This promotes trade by lowering the cost of acquiring import-competing goods via international trade rather than via domestic production. Secondly, the historical simulation revealed technical change towards greater usage of commodities that are import-intensive. In BOTE, such autonomous increases in commodity demand are represented by a rise in A_C. Over the study period, positive movements in A_C were highest for such import-intensive commodities as *machinery and equipment* (which includes computers), *non-metal products* (which includes cement), *metal products*, and *chemicals*. For each of these commodities, imports comprise about three-quarters of domestic demand.

The rapid growth in trade accounts for the large gap between the outcomes for real GDP at market prices (row 1) and real GDP at factor cost (row 2) in column 1. Like many developing countries, at the start of the simulation period Vietnam relied heavily on indirect taxes, particularly on imports and exports. These taxes cause commodity valuations at market prices and factor cost to differ substantially. For example, at the start of the study period, weighted average import tariffs and export taxes were 13.2 per cent and 7.6 per cent respectively. As a result, when export and import volumes expand relative to activity in general, a sizeable allocative efficiency gain (represented by the gap between outcomes for real GDP at market prices and factor cost) is generated.

Table 5 reports sectoral results. Results for individual sectors reflect the influences of both macroeconomic outcomes and details of the sectoral technical change shocks. As is clear from column 1 of Table 5, for most sectors, technical change had a positive impact on output. However it is also clear that technical change had diverse impacts on sectoral output.

Table 4. Decomposition results, macro variables

(Percentage changes from 1996 to 2003, unless otherwise stated)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Description	Technical change	Shifts in foreign demand and export import prices	Employment growth	Changes in Household tastes	Changes in land use	VAT	Changes in trade taxes	Changes in import-domestic preferences	Others	Total	Annual change
	DS	F	DF	DS	DF	DP	DP	DS	DS, F, DP		
1 Real GDP	23.2	14.7	9.4	4.6	2.1	2.2	1.5	0.3	0.4	58.3	6.8
2 Real GDP at factor costs	16.7	13.7	9.3	3.9	3.4	1.6	1.3	-0.1	1.5	51.3	6.1
3 Real GNE	19.2	29.1	8.1	3.8	1.8	1.5	1.3	0.1	-4.2	60.9	7.0
4 Real GNP	24.3	30.9	8.3	3.3	1.9	0.8	0.2	0.4	-3.1	67.0	7.6
5 Real private consumption	22.3	28.9	7.7	3.1	1.8	0.8	0.2	0.3	-18.2	47.0	5.7
6 Real public consumption	20.7	27.2	7.3	3.0	1.8	0.8	0.2	0.3	-28.8	32.4	4.1
7 Real investment	11.9	32.4	9.7	6.2	1.7	3.8	4.8	-0.4	30.2	100.2	10.4
8 Real exports	62.8	23.4	13.9	14.4	2.6	7.2	6.3	-0.6	14.7	144.8	13.6
9 Real imports	46.3	54.0	10.0	10.9	1.8	4.7	5.1	-0.7	1.8	133.9	12.9
10 Aggregate employment, hours weighted	0.0	0.0	10.5	0.0	0.0	0.0	0.0	0.0	0.0	10.5	1.4
11 Aggregate employment, wage weighted	-1.1	8.7	10.6	4.0	-0.3	1.0	0.3	0.0	-0.5	22.7	3.0
12 Aggregate capital stock	9.9	30.9	8.9	4.9	1.5	3.7	4.4	-0.2	7.3	71.3	8.0
13 Aggregate land use	0.0	0.0	0.0	0.0	26.4	0.0	0.0	0.0	0.0	26.4	3.4
14 Real wage, CPI deflated	7.8	22.8	-6.0	-1.6	7.5	-5.4	5.2	0.0	3.1	33.5	4.2
15 Real depreciation	10.6	-27.4	3.4	3.4	-0.8	-7.5	1.6	0.0	7.8	-8.8	-1.3
16 Terms of trade	-8.0	23.8	-1.9	-2.4	-1.4	-0.9	-0.8	0.0	-2.1	6.4	0.9
17 Change in BOT/GDP ratio (x100)	-1.7	2.3	0.0	-0.8	-0.3	1.1	-0.4	0.2	2.0	2.3	0.3
18 Change in NFL/GDP ratio (x100)	5.8	-2.5	6.0	6.3	-0.9	-8.3	5.6	-0.6	-35.2	-24.0	-3.8
19 GDP deflator	-1.1	15.9	-1.7	-1.3	0.3	-2.3	-1.0	0.1	34.0	42.9	5.2
20 Price deflator for consumption	-1.3	1.0	-0.3	0.0	0.5	-0.7	0.1	0.0	37.1	36.3	4.5
21 Export price index, domestic currency	3.4	8.4	0.4	0.3	-2.3	-12.6	0.2	0.0	40.8	38.6	4.8
22 Import price index, domestic currency	12.4	-18.6	2.5	2.9	-0.7	-11.2	1.1	0.0	41.9	30.3	3.9
23 Investment price index	22.3	-5.0	0.0	1.7	2.1	-7.7	-1.6	0.1	31.1	43.0	5.2
24 Average price of capital	22.2	-5.1	0.0	1.7	2.0	-7.7	-1.6	0.1	31.1	42.8	5.2

Table 5. Decomposition results for output by 22 aggregate sectors

(Percentage changes from 1996 to 2003)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Technical change	Shifts in foreign demand and export import prices	Employment growth	Changes in household tastes	Changes in land use	VAT	Changes in trade taxes	Changes in import-domestic preferences	Others	Total	Annual average change
1. Agriculture	38.3	0.1	8.1	-5.0	14.4	-1.1	-0.1	-0.1	0.1	54.8	6.4
2. Mining	80.7	-5.8	4.1	1.9	-2.7	11.0	1.0	1.3	6.9	98.5	10.3
3. Food, beverage and tobacco products	36.7	17.9	10.2	19.2	12.7	-0.9	0.0	-1.2	-7.7	86.8	9.3
4. Non-metal products	43.4	6.9	13.7	9.6	-5.9	8.5	8.3	-7.8	23.0	99.8	10.4
5. Chemicals	56.5	11.1	16.4	19.2	-3.7	-2.6	-2.7	32.0	9.3	135.5	13.0
6. Machines and equipments	50.3	51.1	15.0	20.4	-7.9	-13.0	0.8	-16.9	10.3	110.1	11.2
7. Metal products	52.4	-13.2	20.6	7.8	-9.7	-11.5	-1.7	94.7	27.2	166.6	15.0
8. Textile, clothing and footwear	34.8	60.0	23.7	12.2	-20.3	-0.2	9.6	-9.9	20.5	130.4	12.7
9. Other manufacturing products	47.9	26.6	12.9	-23.8	-5.2	2.9	6.3	-1.9	-0.4	65.4	7.5
10. Utilities	54.3	33.9	13.8	12.8	-2.3	0.1	2.9	2.5	6.0	124.0	12.2
11. Construction	-10.1	29.8	9.1	5.9	1.5	3.4	4.2	-0.4	29.9	73.4	8.2
12. Trade and repair	24.5	21.9	10.3	2.0	1.2	2.5	3.2	0.1	3.3	69.1	7.8
13. Hotels and restaurants	-10.9	48.6	13.7	-3.9	-6.8	2.0	0.8	0.0	6.5	50.2	6.0
14. Transport and communications	15.6	15.9	12.0	12.3	-1.1	14.7	4.2	-1.6	8.7	80.5	8.8
15. Tourism	18.2	28.3	16.6	55.4	-10.7	0.2	3.1	-13.3	12.0	109.9	11.2
16. Financial services	142.2	-35.8	16.7	19.8	-11.5	-9.7	-2.2	-13.3	8.4	114.7	11.5
17. Dwellings	29.9	29.5	7.9	5.5	1.5	1.8	0.7	0.3	-21.5	55.5	6.5
18. Property and business services	18.4	19.1	8.6	-1.2	0.0	3.0	1.7	-0.1	-4.1	45.3	5.5
19. Public administration	21.1	26.3	7.8	3.2	1.5	0.6	0.2	0.4	-22.5	38.5	4.8
20. Education	27.4	25.3	10.9	37.6	-0.5	1.6	-1.1	-0.3	-18.1	82.5	9.0
21. Health care	19.9	24.7	9.8	2.1	-0.9	0.1	-0.7	0.5	-16.3	39.1	4.8
22. Other services	45.2	5.9	12.1	13.5	-4.2	5.6	-1.9	-0.2	-23.1	52.9	6.3
Aggregate results for three broad sectors											
1. Agriculture	38.3	0.1	8.1	-5.0	14.4	-1.1	-0.1	-0.1	0.1	54.8	6.4
2. Mining, Manufacturing, Construction	38.0	21.2	11.5	9.3	-1.0	2.6	3.1	0.9	12.0	97.5	10.2
3. Services	28.5	20.6	10.7	8.2	-1.1	2.9	1.1	-0.8	-7.1	62.9	7.2

The sectors that experienced the largest output gains as a result of technical change were *financial services* (row 16), *mining* (row 2), *chemicals* (row 5), *utilities* (row 10), *metal products* (row 7), and *machinery and equipment* (row 6). Only two sectors contracted, namely *construction* (row 11) and *hotels and restaurants* (row 13). Sectoral output outcomes can be explained in terms of technical changes in the sector and changes in macroeconomic environment (such as the large increases in exports and imports, the more moderate increases in final consumption and investment, and the depreciation of the exchange rate). Winners tend to be the sectors which: (a) experience large technical improvements in production; (b) produce goods experiencing favourable input-using technical change shifts; (c) sell large proportions of their output to exports; and/or, (d) are import-competing.

Consider for example *financial services* (row 16), the sector experiencing the largest gain in output. Technical change had favourable supply-side and demand-side influences on this sector. On the supply side, the sector experienced a large (37 per cent) improvement in input-using technical change. This caused *financial services* output prices to fall, inducing substitution towards this commodity. On the demand side, since the sector sells approximately 49 per cent of its output in export markets, it was favourably affected by real depreciation.

In contrast, technical change had unfavourable supply-side and demand-side impacts on the *construction* sector (row 11). Technical change had two unfavourable influences on the sector's supply-side. First, the sector appears to have become less efficient over the study period, experiencing technical regression of 12.3 per cent[28]. Second, the sector is relatively intensive in the use of imports (such as cement) and labour. Hence technical-change-induced real depreciation and real wage growth caused per-unit production costs for this sector to rise. On the demand-side, we have already seen that the macroeconomic effects of technical change cause the change in aggregate investment to be far lower than the change in real GDP. Since 96 per cent of *construction* output is sold to investment activities, this damps this sector's relative growth prospects.

As we discussed earlier, the outcomes in column 1 are attributable to five sets of technical change. By far the most important of these were movements in industry-specific primary factor technical change. Their relative importance is apparent if we consider that, of the 23.2 percentage points of real GDP growth attributable to technical change, 19.7 percentage points were due to industry-specific movements in primary factor technical change[29]. In Table 6 we decompose the real GDP result in column 1 into the individual contributions of industry-specific movements in primary factor technical change, and a small residual. We discuss Table 6 in the remainder of this section. By focussing on industry-specific technical change movements, we aim to shed light on the underlying sources of Vietnamese productivity growth over the period.

Table 6. Percentage point contributions of industry-specific technical change to real GDP growth, 1996-2003

	Sector	Changes in primary-factor technology	Contribution to GDP	Shares in GDP at factor costs	Ratio Contribution/share
1	Agriculture	-22.3	12.4	29.2	0.4
2	Mining	-35.0	8.0	6.2	1.3
3	Food, beverage and tobacco products	-20.0	0.7	6.2	0.1
4	Non-metal products	2.5	-0.1	2.9	-0.0
5	Chemicals	-3.4	0.1	1.3	0.1
6	Machines and equipments	19.8	-0.3	1.2	-0.2
7	Metal products	1.0	-0.0	0.7	-0.0
8	Textile, clothing and footwear	-7.0	0.6	3.1	0.2
9	Other manufacturing products	0.8	-0.0	1.2	-0.0
10	Utilities	-0.2	-0.0	2.3	-0.0
11	Construction	47.6	-3.0	7.5	-0.4
12	Trade and repair	29.2	-3.2	12.7	-0.2
13	Hotels and restaurants	14.0	-0.7	3.1	-0.2
14	Transport and communications	3.7	-0.1	3.9	-0.0
15	Tourism	-3.0	0.0	0.1	0.1
16	Financial services	-51.5	2.3	1.6	1.4
17	Dwellings	-35.9	-0.2	2.8	-0.1
18	Property and business services	-19.4	0.2	1.5	0.2
19	Public administration	-29.2	0.5	4.3	0.1
20	Education	-23.7	0.8	3.3	0.3
21	Health care	-10.3	0.1	1.5	0.1
22	Other services	-29.0	1.4	3.4	0.4
23	Technical change in commodity use and capital formation	na	3.5	na	na
24	**Total**		**23.2**	**100.0**	**na**

(Note: The negative sign of changes in technology (column 2) represents technological improvement, because it means less factor inputs are now required for the same level of output)

Financial services (row 16) experienced the largest improvement in primary factor productivity (column 1)[30]. This allowed it to make a sizeable contribution to real GDP growth (column 2) despite accounting for only a small share of GDP (column 3). We think this productivity growth is due to both technical changes (such as increased use of information technology) and policy reform. In the period prior to and during the study period, there were a number of polices aimed at increasing efficiency and competition in financial services. These included government-sponsored staff training programs to improve the professional competence of Vietnamese banks and financial institution, and the granting of licences to many private and foreign banks (Vu Viet Ngoan 2003, Van Arkardie and Mallon 2003: 97-101, Nguyen Viet Hung 2007).

Primary factor productivity growth in *agriculture* (row 1, column 1) was approximately half that of *financial services*. However, agriculture accounts for a much higher share of GDP (row 1, column 3) and as a result, agricultural productivity growth accounted for over half of all real GDP growth attributable to technical change (row 1, column 2). We suspect that policy change played a key role in promoting productivity growth in *agriculture*. During the study period, farmers' rights to use, transfer, exchange, inherit and mortgage land were increased by amendments in 2001 and 2003 to the Land Law (1988, 1993). These laws greatly improved farmer incentives to use land efficiently and respond to market demands (Marsh and MacAulay 2006). Kompas (2004) presents evidence for policy-induced improvement in agricultural productivity, finding that improved incentives accounted for approximately one third of the 4.5 per cent per annum growth in total factor productivity in rice production over 1995-1999. Allocative efficiency in agriculture also

improved, with a shift in land use from paddy rice cultivation to other plants, and from farming to aquaculture and livestock, uses with higher productivity and market value (CIEM 2003:25). Another important factor was government investment in irrigation, transport infrastructure and other agricultural services (Van Arkardie and Mallon 2003:195), all of which were likely to have improved agricultural productivity. Foreign investment may also have played a role, with anecdotal evidence of significant amounts of foreign direct investment in agricultural production and agricultural services, bringing with it new technologies and production techniques.

Primary factor productivity growth in *mining* accounted for approximately one third of the gain in real GDP attributable to technical change (row 2, column 2). Our estimate for this sector's productivity growth can be traced to our inputs: over the study period GSO statistics indicate that the sector's value added at constant prices increased by just over 80 per cent, while its use of labour and capital grew by only 27 and 68 per cent respectively. We suspect that, rather than growth in productivity, part of the increase in *mining* output is likely to be the result of the opening of new mines and oil fields. Unfortunately, the GSO publishes no data that allows us to distinguish the contributions to mining output growth of additional sub-soil assets and productivity.

Apparent technical deterioration in two sectors (*construction* and *trade and repairs*) detracted just over 6 percentage points from potential real GDP growth (rows 11 and 12, column 2). A number of studies of the Vietnamese construction sector have noted an increase in waste in this sector over the study period, which may account for our finding of technical deterioration[31]. In the case of *trade and repairs*, we are unaware of any existing studies into this sector that might illuminate potential sources of the apparent technical deterioration. Hence we cannot rule out inconsistencies in GSO data on *trade and repairs* inputs and outputs[32].

2. Foreign demands and trade prices (column 2)

Equations (E13) and (E14) are simplified representations of the MVN equations determining the percentage changes in the foreign currency export price ($p_i^{(X)}$) and export volume ($q_i^{(X)}$) of commodity *i*:

$$p_i^{(X)} = p_i^{(0)} + \phi + mu_i^{(X)} \qquad \text{(E13)}$$

$$q_i^{(X)} = \eta_i (p_i^{(X)} + f_i^{(X)}) \qquad \text{(E14)}$$

where $p_i^{(0)}$ is the percentage change in the basic price of good *i* denominated in domestic currency units, ϕ is the percentage change in the nominal exchange rate, $mu_i^{(X)}$ is the percentage change in the power (one plus the rate) of a mark-up when supplying good *i* to the export market; $q_i^{(X)}$ is the percentage change in foreign demand for good *i*, and $f_i^{(X)}$ is a vertical (willingness to pay) shift in the position of the foreign demand schedule for good *i*.

In the historical simulation, $p_i^{(X)}$ and $q_i^{(X)}$ are exogenous (and shocked equal to their historically observed values as reported in official statistics), and $mu_i^{(X)}$ and $f_i^{(X)}$ are endogenous. In the decomposition simulation, the values for the historical movements in

$mu_i^{(X)}$ and $f_i^{(X)}$ are fed into the model as exogenous shocks, with $p_i^{(X)}$ and $q_i^{(X)}$ endogenous. Column (2) of Table 4 reports the impacts of movements in $mu_i^{(X)}$, $f_i^{(X)}$, and commodity-specific foreign currency import prices[33].

Taken together, the historical movements in $mu_i^{(X)}$, $f_i^{(X)}$ and commodity-specific import prices revealed that foreign trading conditions for Vietnam were highly favourable over the period. The exported-weighted movement in $f_i^{(X)}$ was 21 per cent, implying that foreign willingness to pay for Vietnamese exports increased by about one fifth. In part, this simply reflects growth in world income. World growth likely accounts for about 6 percentage points of the 21 percentage point increase in willingness to pay[34]. We expect the remainder is due to changes specific to Vietnamese export markets. These might include: genuine increases in foreigners' preferences for Vietnamese commodities due to the marketing efforts of Vietnamese exporters; growth in export-oriented enterprises with significant foreign direct investment and thus ready-access to foreign markets via parent and affiliated firms; reductions in foreign tariffs and other trade barriers arising from the trade agreements that Vietnam entered over the period. These included the ASIAN Free Trade Agreement (AFTA), the Vietnam-US bilateral trade agreement, and trade agreements with the European Union and other countries[35]. Changes in trade policies may also account for small shifts in export supply curves ($mu_i^{(X)}$). The historical simulation shows that these mark-ups were reduced for most products, particularly *agriculture, food products, machinery and equipment, chemicals and metal products*. Decreases in mark-ups can be explained by policies which reduced the indirect costs of exporting. These changes included the removal of some export quotas (such as quota on the export of rice); the removal of the export licence system in 1998; the streamlining of customs clearance procedures to shorten processing times and reduce unofficial customs fees; and the relaxation of foreign exchange control (Auffret 2003, Authukorala 2005). The mark-ups increased for *mining* products. This reflects the limited adjustment of mining capital in response to the big increase in the world price for crude oil and gas that occurred over the period.

At the macroeconomic level, the net favourable shifts in commodity-specific aspects of Vietnam's foreign trading conditions are reflected in the positive outcome for the terms of trade (row 16, column 2). The macroeconomic effects of higher terms of trade can be traced with the aid of BOTE. Via (E9), with technology, rates of return and employment unchanged, the improvement in the terms of trade lifts the capital stock (row 12). Via (E10), the increase in capital and the terms of trade causes the real wage to rise (row 14). The increase in K also causes real GDP to be higher (row 1), making favourable foreign trading shifts the second-most important contributor to Vietnamese real GDP growth over the study period. Real GNP (row 4) rises faster than real GDP due to the improvement in the terms of trade. With GNP rising faster than real GDP, so too do private and public consumption (rows 5 and 6). Comparing results in rows 5 and 6 across columns, it is clear that much of the growth in Vietnam's real consumption was attributable to favourable shifts in both foreign markets and domestic supply conditions to such markets. For example, of the 47 percentage point increase in real private consumption spending (column 10, row 5), 28.9 percentage points (61 per cent) was attributable to the factors summarised in column (2).

The sectoral effects of trade-related shocks are reported in column (2) of Table 5. In part, these reflect features of the macroeconomic results. For example, the growth in real consumption relative to real GDP in column (2) implies that consumption-oriented services and manufacturing industries will tend to experience the most favourable output expansions in column (2) of Table 4. However the commodity-specific details of the shifts in $mu_i^{(X)}$, $f_i^{(X)}$ and import prices also matter.

3. Population and employment growth (column 3)

Aggregate hours worked increased by 10.5 per cent over the study period (column 3, row 10). This is in line with the 10.6 per cent growth in total population (GSO 1998, 2005), but substantially lower than growth in the relevant population benchmark - the working age population - which grew by 21 per cent. The gap between employment growth and growth in the working age population can be explained by falls in the participation rate and average hours worked per worker. The participation rate declined by 1.7 per cent over the study period (ILO 2006). Average weekly hours worked per worker declined by 9 per cent. This likely reflects the effects of the optional change from 48-hour to 40-hour working week, introduced by the Vietnamese government in 1999 (GOV 1999). The unemployment rate was little changed over the study period.

The macroeconomic effects of employment growth can be traced with the aid of BOTE. From (E9) and (E2) it is apparent that (leaving aside for the moment changes in TOT) the 10.5 per cent increase in employment should lead to a similar increase in K (via E9) and in real GDP (via E2). This accounts for the large contribution to real GDP growth (row 1) made by employment growth (column 3). However, via (E6), a larger domestic economy requires imports to expand (row 9). Equation (E1) requires that this be matched by export growth (row 9). This causes the terms of trade to decline (row 16). It is this decline in the terms of trade that accounts for capital growth (row 12) being less than employment growth (row 11). As a result, GDP growth (row 1) is also less than employment growth. Via (E10), the falls in the K/L ratio and the terms of trade cause the real wage to decline (row 14).

Real GNE (row 3) expands by less than real GDP (row 1). This is due to the decline in the terms of trade, and some foreign financing of the capital stock expansion (row 18). With GNE growing by less than real GDP, via (E11) real consumption growth must be less than real GDP growth. As a result, the real balance of trade moves towards surplus (rows 8 and 9) requiring real depreciation (row 15).

The impact of employment growth on sectoral output is reported in column 3 of Table 5. Consistent with the nearly uniform expansions in K and L, and the nearly uniform expansions in the demand side components of GDP, the sectoral outcomes are relatively uniform. However real depreciation promotes expansion of sectors exposed to international trade relative to sectors more exposed to domestic consumption and investment spending. Real depreciation accounts for the expansion of export-oriented sectors such as *TCF*, *tourism* and *financial services*, and import-competing sectors such as *metal products, chemicals,* and *machinery and equipment*. *Mining* and *agriculture* are also export-oriented, but the ability of these sectors to expand is constrained by fixed natural resource endowments.

4. Changes in household tastes (column 4)

The percentage change form of the MVN household demand equations is:

$$x_{H,i} = q + \varepsilon_i (c - q) + \Sigma_j \eta_{ij} p_{H,j} + a_{H,i} - \Sigma_k S_{H,k} a_{H,k} \qquad \text{(E15)}$$

where $x_{H,i}$ is household demand for commodity i; q is the number of households; ε_i is the expenditure elasticity for i; c is household income; η_{ij} is the elasticity of demand for i with respect to the price of j; $p_{H,j}$ is the consumer price of commodity j; $a_{H,i}$ is a shift in tastes towards i; and $S_{H,k}$ is the share of spending on k in the household budget. In the historical simulation, observed changes in consumer prices and quantity demanded for 93 commodities are used to tie-down movements in $x_{H,i}$ and $p_{H,j}$, leaving (E14) to determine movements in household tastes, $a_{H,i}$. The historical simulation revealed shifts in household tastes towards services (such as tourism, transport and communication, financial services, education, utilities), and manufacturing products (such as machinery and equipment, pharmaceuticals, and personal hygiene and cosmetic products). Household tastes changed away from primary commodities (such as agriculture, mining and metal products).

In the decomposition simulation, the $a_{H,i}$'s are exogenous and set equal to their historical simulation values. Column 4, Table 5, isolates the effects of these taste changes on sectoral outputs. The changes in households' tastes affect household demand for commodities via (E14). The equation shows that, in the absence of changes in prices and income, household demand for a product moves broadly in proportion with changes in their preference for it. Hence, sectors experiencing positive shifts in household preference for their products will tend to expand, whereas sectors producing products experiencing adverse preference shifts will tend to contract. Naturally, the degree to which a sector's output is affected by consumption shifts will depend on the importance of sales to consumption in the sector's total sales. For example, the historical simulation revealed a large shift in household preferences towards output of the *chemicals* sector, reflecting autonomous shifts in demand for commodities such as medicines, soaps, and cosmetics. Positive preference shifts for these commodities were much greater than the positive preference shift towards *education*. However *chemicals* sells only 19 per cent of its output to households, whereas *education* sells 83 per cent of its output to households. We see this in column 4 of Table 5: both *chemicals* and *education* expand, but *education* by the most.

The effects of changes in household preferences on macroeconomic variables are small (see column 4, Table 4). The macro effects arise mainly from changes in household preference shifting activity between sectors with different K/L ratios. The sectors that were favoured by household preference change tended to be more capital-intensive than those experiencing adverse preference shifts. In particular, the capital share in primary factor payments for expanding industries is 34 per cent, while that for contracting industries is 18 per cent. With national employment fixed in this column, the shift in the composition of consumption demand towards output of capital-intensive sectors causes the capital stock to expand (row 12). Although hours of employment are fixed, wage-weighted employment

rises by 4.0 per cent (rows 10 and 11). This is due to expansion of high wage sectors (such as *manufacturing* and *utilities*) and the contraction of low wage sectors (such as *agriculture*). Together, the increase in the capital stock and wage-weighted employment account for the rises in GDP and GNP.

5. Changes in land use (column 5)

The study period saw a 21 per cent increase in usage of land and water surface area (hereafter, "land") by agriculture. The largest increases in land usage were by *coffee beans* (101 per cent), *fishery* (74 per cent) and *raw rubber* (73 per cent) (GSO 1998, 2005c). Using rental rates to weight observed changes in area, aggregate land supply increased by 26.4 per cent over the study period (row 13, column 5, Table 4).

Changes in sectoral outputs are reported in column 5, Table 5. Because land is sector-specific, the increase in agricultural land supply benefits agriculture (row 1) and industries that process agricultural products (row 3). These sectors are export-oriented, so this favourable supply shock causes a small-scaled 'Dutch disease' effect (Corden 1984). This is apparent from row 15, Table 4, where we find a small appreciation of the real exchange rate to crowd out non-agricultural exports. This accounts for the contractions in trade-exposed sectors such as *TCF, tourism, financial services,* and *hotels and restaurants*.

The macroeconomic effects of expansion of land use are small (column 5, Table 4). With higher land inputs, the marginal product of capital in agricultural industries rises. Since rates of return are exogenous, agricultural capital stocks rise. This accounts for the increase in the aggregate capital stock (row 12). The increase in land and capital supply accounts for the increases in real GDP, real GNP and real consumption (rows 1 and 4-6).

6. Changes in domestic indirect taxes (column 6)

Indirect taxes include taxes on products and other taxes on production. In this column we examine only the effects of changes in taxes in domestic production and final demands. The effects of tariffs and export taxes will be examined separately in column 7.

During the period, the biggest change to the indirect tax system was the introduction of the value-added tax (VAT) system in 1999 to replace the cascading and complex turnover tax (VN National Assembly 1997). Basically, this reform removed taxes on intermediate inputs to production and investment[36], and sales taxes on exports. Households now pay VAT on their purchase of goods and services. Until the end of 2003, the VAT had four rates: 0, 5, 10 and 20 per cent, with 10 per cent being the standard rate[37]. For household consumption, these rates on most goods and services are higher than the former sales tax rates calculated from the input-output tables for 1996. The biggest increase was on *financial services* (from almost zero to 15 per cent), *hotels and restaurants* (from 6.3 to 20 per cent). The tax rates on many *food, textile and clothing* products increased from less than 5 per cent to 10 per cent. However, the rates decreased for *transport and communication* (from about 30 to 10 per cent), *education* (from 1.1 per cent to zero), and *other services* (from 9.9 to 7.3 per cent). Apart from the VAT, there were some small changes to production taxes, such as agricultural and land use tax. Overall, revenues from indirect taxes on products over the period increased by 106.3 per cent, and revenue from taxes on production decreased by 55.6 per cent (IMF 2000, 2003). In the historical simulation, changes to the indirect tax rates were introduced, and scaled so that changes in

tax revenues reflect the observed changes over the period. In the decomposition simulation, the resulting changes in indirect tax rates from the historical simulation were imposed on the model. Their effects on the economy are reported in column 6, Tables 4 and 5.

The main effects come from the introduction of VAT. The immediate effects of VAT is the reduction in the prices of all exports, most prices of intermediate inputs to current production and capital formation, and the increase in the prices of many commodities for final consumption.

The removal of sales taxes on exports (Tx in E7) increases exports (row 8), causing the ToT to worsen (row 16). The removal of indirect taxes on capital formation (T_I in E9) causes the investment price index to fall (row 23). With the rate of return on capital exogenous, the price of capital also falls, causing capital stock and investment to increase (rows 7 and 12). In this column aggregate employment hours do not change, but changes in production structure cause wage-weighted aggregate employment to increase slightly (row 11). The increases in K and L cause GDP to rise (row 1). GNP rises less than GDP due to the worsening of the terms of trade. Final consumption also rises with GNP. GNE increases less than GDP, causing the balance of trade to move toward surplus (row 19) via a real appreciation (row 15). GDP deflator falls relative to import prices due to a reduction in production costs, which resulted from the reduction in taxes on intermediate goods (row 19).

Changes in tax rates and the real appreciation are the most important determinant of sectoral performance (see column 6, Table 5). The removal of sales taxes on exports benefits export-oriented sectors, and the increase in taxes on goods for private consumption harm sectors which sells mostly to that user. Import-competing industries may suffer because of the real appreciation.

The biggest winners include *transport and communication, mining, non-metal products,* and *other services* because the tax rates on their sales to exports and to final consumption decreased the most. `The *mining* sector gain from a significant reduction in the tax on its exports, which was reduced from 27.4 per cent to zero. *Other services* gains because, unlike many other commodities, the tax rates on its sales to private consumption actually fell.

The biggest losers include *machines and equipment*, *metal products, financial service*s and *chemicals*. Except for *financial services*, all other three sectors are import-intensive, with imports comprising about three fourth of domestic sales. Hence they lose from the real appreciation. They also lose from the increase in their tax rates on final consumption, and gain very little in the reduction of taxes on intermediate inputs and exports, because the original levels of those taxes were small. The *financial service*s sector has a negative tax on intermediate inputs and has no taxes on exports in the base year. Therefore, it does not gain from the removal of taxes on exports, and loses from the increased tax on intermediate input. The tax rates on this sector's sales to private consumption increase from zero to 13.6 per cent. As a result, its sales to households fall, and the sector contracts.

7. Changes in trade taxes (column 7)

Column 7, Tables 4 and 5 reports the effects of changes in tariff rates and export tax rates (T_M and T_X in BOTE). Over the study period, there was a reduction in the average tariff

rates and the average export tax rates. However, the changes were small: import-weighted average tariff rate fell from 13.2 to 12.4 per cent, and export-weighted average rate of export tax fell from 1.28 to 0.84. Therefore, their effects on the economy were also small.

At the macro level, the immediate effects of the reduction in tariff rates and export tax rates are to lower prices of imports and exports, resulting in an increase in the volumes of both imports and exports (rows 8 and 9). Cheaper imports lower the price of investment (row 23), because investment is relatively more import-intensive than private consumption. This causes investment and capital stock to rise (rows 7 and 12). The increase in capital stock causes GDP to increase (row 1), but the decline in the terms of trade (row 16) due to export expansion causes GNP to stay virtually unchanged (row 4). As a result, there is almost no change in private and public consumption (rows 5 and 6). Net foreign liabilities increase to finance the increase in capital stock (row 18). The increase in K/L ratio causes the real wage to increase (row 14).

Changes in sectoral outputs due to changes in trade taxes are reported in column 7, Table 5. Changes in a sector's output depend on the magnitude of the change in its tariff rate, its exposure to import competition, its export-orientation and its labour-intensity. For an import-competing sector, the larger the tariff cut and the higher the import competition, the more negative effect of the tariff cut the sector would experience. For an export-oriented sector, the larger the cut in export tax rate and the higher the share of exports in the sector's total sales, the greater is its output expansion. However, all sectors are subject to the increase in the economy-wide real wage, hence the more labour-intensive sectors would suffer more from its effects.

Simulation results show that the biggest winners from changes in trade taxes are *TCF, non-metal products, other manufactured products, construction*, and *transport and communication*. Tariff rates on the imports of three first products actually rose slightly during the period and so the domestic sectors gain. They also gain from the expansion in exports. *Construction* gains from the expansion of investment, and *transport and communication* gain from the increased demand for them as margin services to the expanding exports.

The biggest losers are *chemicals, financial services*, *other services*, and *metal products*, although their contractions are small. The *chemicals* sector experiences the biggest reduction in the power of tariff on competing imports (-9.9 per cent). This sector is subject to high import competition, with imports comprising 75.2 per cent of total domestic purchases. Tariff cuts caused the duty-paid import price for *chemicals* to fall by 11.0 per cent, inducing substitution toward imports and away from domestically-produced chemical products. Similarly, the *metal products* sector suffers from the higher import competition due to the tariff cuts on their competing imports. The labour-intensive sectors *financial services* and *other services* do not gain from changes in trade taxes because there are no trade taxes on services, but lose from the increase in real wage.

8. Preferences for imported/domestic varieties of each good (column 8)

Column 8 isolates the effects of shifts in commodity-specific import/domestic preference variables. For each non-government domestic agent in MVN[38], the percentage change in the ratio of imported to domestic demands for good *i* are given by equations of the form:

$$(x_{i,imp} - x_{i,dom}) = -\sigma_i (p_{i,imp} - p_{i,dom}) + twistm_i \qquad \text{(E16)}$$

where $x_{i,imp}$ and $x_{i,dom}$ are the percentage changes in the demand for imported and domestic good i respectively; $p_{i,imp}$ and $p_{i,dom}$ are the percentage changes in the prices of imported and domestic varieties of good i respectively; σ_i is the elasticity of substitution between domestic and imported i; and $twistm_i$ is a cost-neutral shift in preferences for imported/domestic varieties of good i.

In the historical simulation the $twistm_i$ variables are determined endogenously by (E13), with $x_{i,imp}$ exogenous, and $p_{i,imp}$, $x_{i,dom}$ and $p_{i,dom}$ determined elsewhere in the model. Hence movements in $twistm_i$ accommodate that part of the historically observed change in the import / domestic ratio for commodity *i* not explained by the movement in the prices of the imported and domestic varieties of *i*. In the decomposition simulation, the historical movements in the $twistm_i$'s are imposed as exogenous shocks. In BOTE, twists are represented by the variable T in (E6). Over the study period, the twists varied between commodities. They are strongly favourable for imports of *machines and equipments*, *mining, TCF* and *tourism*. They are strongly favourable for domestically-produced *metal products* and *chemicals*. On average, the twists slightly favour imports (average *twistm* = 6 per cent).

One the one hand, the twists may reflect actual changes in users' preference toward one or the other source of supply. For example, the increase in preference towards *machinery and equipment* is very likely to be the effects of an increased consumers' awareness of newer types and greater variety of imported products, such as computers, mobile phones. Or the increase in preference toward *domestic* chemical products is likely to be the results of a greater variety and better quality of domestic products.

On the other hand, the twists may also reflect changes in the regulatory environment which have not been modelled explicitly in the model. For example, with the new regulations on entry and exist (GOV 2000), the red tapes associated with application for passports and visas have been reduced significantly, making it easier for Vietnamese residents to travel abroad. This may contribute to the twist toward import of *tourism*, because more people would be able and willing travel overseas even if prices of foreign tours remain the same. The twist toward imported *financial services* may reflect the fact that more foreign banks were allowed into Vietnam and they were allowed to conduct more types of transactions (World Bank 2002). The twist toward imported *machinery and equipments* may be a result of the reduction of a number of quantitative restrictions on the imports of consumer goods, including household appliances, electronic goods, and motor vehicles (CIE 1998:27-28). On the other hand, the twists toward domestic *metal* and *chemical* products may be explained by the existence of quantitative restriction on imports of steel, petroleum products, and chemical fertilizers (USTR 2004).

These twists directly affect outputs of domestic sectors (column 8, Table 5). Losers are sectors which experienced a large twist toward competing imports, such as *machines and equipments, financial services,* and *tourism*. Winners are sectors which experienced a large twist toward domestic goods, such as *metal products* and *chemicals*. The larger is the degree of import competition, measured by the share of imports in total local sales of the

product, the larger would be the effects. Because there are opposing effects of the twists on different sectors, the effects of the twists on the macroeconomic variables are very small.

9. Other changes (column 9)

The results in column 9, Tables 4 and 5, summarise the effects of shocks to a number of variables. Among the more important of these variables are: the ratio of total consumption to GNP, the ratio of public to private consumption, investment-capital ratios by industry, inflation, foreign borrowing, foreign transfers, and the ratio of net foreign liabilities to GDP.

In the historical simulation, real private and public consumption spending (C and G in BOTE) are determined exogenously at their GSO values. The model determines the ratio of total consumption to GNP, and the ratio of private to public consumption (Γ and APC in BOTE). The historical simulation revealed a big decrease in APC (12.9 per cent), and a big increase in Γ (11 per cent). They explain the lower growth rate of C and G compared with GNP, and the lower growth rate of G compared with C in column 9, Table 4. The lower growth rate of G compared with C is consistent of the efforts by the Vietnamese government to reduce the size of the public administration machinery, which is one of the objectives of the public administration reform in Vietnam since 1986 (Dinh Xuan Quan 2003, Painter 2003).

In the historical simulation the data on movements in investment and capital stocks (I and K in BOTE) are imposed on the model, leaving the I/K ratio (Ψ in BOTE) to be determined endogenously. The historical simulation revealed that on average, the I/K ratio increased 16 per cent. Changes in this ratio varied between sectors. The largest increases were observed in *ownership of dwellings, financial services, health services,* and *education*. The ratio decreased in *hotels and restaurants, property and other business services,* and *construction*. The increase of 120 per cent in the I/K ratio of the *ownership of dwellings* sector reflect the rapid increase in residential building during the period. When imposed as a shock in the decomposition simulation, this accounts for approximately 11.8 percentage points of the 29.8 per cent increase in real investment in column 8. By contrast, investment in hotels and restaurant was sluggish because of the oversupply in the hotel and office space, which is evident from the declining price of high-end rental property and office space since 1996 (World Bank 2006). The I/K ratio in the real estate market in 2003 was lower than in 1996 due to many new regulations by the government to prevent the real estate bubble (CIEM 2003, World Bank 2006).

Over the period, the consumer price index increased by 37 per cent. Foreign grant and transfers to Vietnam increased by 30 and 180 per cent (IMF 2000, 2003, 2006), and the ratio between net foreign liabilities and GDP decreased by 15.6 per cent. The historical simulation also revealed that there were small decreases (3 and 9 per cent) of mark-ups on private consumption and investment.

The main effect of the decrease in the APC is a sharp decline in both private and public consumption relative to real GNP. The main effect of the increase in Γ is a larger decrease in public consumption relative to private consumption (compare rows 4-6, Table 4). By themselves, these changes would cause export to rise and import to fall, because domestic

consumption falls while there are no changes to the supply side of GDP. Net foreign liabilities fall due to higher savings.

The main effects of the increase in investment-capital ratios are an increase in investment compared with capital stock via (E8) (compare rows 7 and 12, Table 4). These shocks causes exports to fall and import to rise, and thus partly offsetting the effects on trade from the decline in APC and Γ.

The increase in CPI, which is a numeraire in this simulation, raises all price levels in the economy, but has no effects on the real variables.

The main effect of the increase in foreign transfers (including grants and private transfers from foreigners) is to lower the NFL/GDP ratio. This, together with the fall in NFL due to the decrease in final consumption discussed above, is more than offset the increase in foreign borrowing and foreign direct investment. The NFL/GDP falls.
The main effect of the decline in mark-ups on investment is to lower the cost of capital formation, and thus raise the capital stock. The effects of the decline in mark-ups on private consumption are negligible.

The simulation results in column 9, Tables 4 and 5, are the net results of the sometimes opposing effects discussed above. Overall, GDP increase slightly (row 1).

Sectoral effects of this group of shocks are reported in column 9, Table 5. Simulation results show that the biggest winners are *Construction, Metal products, Non-metal products, TCF* and *Tourism*, which sell their outputs mainly to the expanding investment or exports. The first three sectors sell a large proportion of their output either directly to investment or to industries which supply to investment. The two last sectors are export-oriented. The biggest losers are *Dwellings, Other services, Public administration*, and *Health care*, because they sell mainly to the contracting final consumption.

10. Cross-column comparisons

10.1 Macro results (Table 4)

In Table 4, columns (1) – (9) provide a decomposition of the observed outcomes reported in columns (10) and (11). The decomposition is in terms of contributions by supply-side variables (such as technical change and population growth), policy variables (such as changes in trade taxes and the introduction of the VAT) and demand-side variables (such as changes in household tastes). We explain in detail the methodology of the decomposition in Section 2. For the moment, we shall discuss those features of our results that we find most important.

Starting with row (1), real GDP, we find that the biggest contributor to growth over the study period was technical change (column 1). This contributed 39.7 per cent (=23.2/58.3) to the total growth of real GDP over the study period. As we discuss in Section 3.1, much of this contribution can be traced to a large improvement in primary factor productivity. Shifts in foreign demand and changes in domestic supply conditions in the traded goods sector also contributed substantially (25.3 per cent) to real GDP growth (row 1, column 2). As we discuss in Section 3.2, this can be traced to growth in foreign demand for

Vietnamese goods lifting the Vietnamese terms of trade. The third important factor is the growth in employment, contributing 16.2 per cent to GDP growth (row 1, column 3). Together, these three groups of structural changes, representing shifts in technology, foreign trading conditions, and factor endowments, accounted for four fifth of GDP growth over the period.

Changes in household preferences, land areas, indirect taxes, preferences between imports and domestic products, and I/K ratios also contributed positively to GDP. Factors which reduced GDP included the decline in final consumption and the increase in foreign borrowing compared with investment needs.

It may seem surprising that the reduction of trade taxes (import tariffs and export taxes) contribute so little to the growth of real GDP over the study period (only 2.5 per cent, =1.5/58.3, see row 1, column 7). It is because the average reduction in trade taxes was small, and was only a part of the trade liberalisation process in Vietnam. As the results in column 2 indicate, other measures in the trade liberalisation process, such as the reduction of non-tariff barriers to trade and the encouragement of exports, may have contributed much more to the growth of real GDP than the reduction in trade taxes.

The main sources of growth in GNP (row 3) were similar to those of GDP, but shifts in foreign demand for Vietnamese goods played the biggest role (column 2). This is because these shifts improved the economy's terms of trade (row 16, column 2), which allowed the economy to receive more for its exports and pay less for its imports.

Factors which contributed the most to the increase in private consumption (row 5) were the improvement in the terms of trade and technology, because they allowed the real wage and GNP to increase, thus increasing household disposable income. Public consumption, assumed to move with private consumption, also gained most from these groups of shocks. These gains are more than offset the decline in final consumption due to the decrease in the average propensity to consume out of GN and the decrease in public/private consumption ratio.

As for investment (row 7), the most important positive factors were the favourable changes in international trading environment (column 2) and the positive change in I/K ratios (included in column 9). Many policy reforms, such as the Land Law, the Law on Encouragement of Domestic Investment, and the Enterprise Law, which give higher recognition and protection of private enterprises and property rights, may have contributed to the increase in investors' confidence, leading to higher investment-capital ratios.

For exports and imports (rows 8 and 9), again changes in technology, shifts in foreign demands and the increase in employment played the most important roles, contributing to more than three forth of growth in trade. However, the role of each factor was different for exports and imports. For exports, technical improvement was the most important factor because it resulted in a real depreciation and made exports more competitive. The second important factor is shifts in foreign demands because they allowed the country to export more at every price. Employment growth also drove down production costs, making exports more competitive on the world market. For imports, the most important factor was the change in the terms of trade, which made imports relatively cheaper than domestically-produced products.

During the period capital stocks grew strongly at an average of 8 per cent per annum (row 12). The most important factor for the growth in capital stocks was the improvement in international trading environment (column 2), which increase the demand for Vietnamese exports and causing production expansion. The second important factor was technical change, followed by employment growth and changes in household tastes. These factors were also important in explaining the increase in the real wage, which increased with the increase of capital-labour ratio and vice versa.

Factor reallocation has been recognised as one of the sources of growth (Syrquin 1986). In this paper we found that due to the movement of labour from low wage sector (mainly agricultural industries) to higher wage manufacturing and services factor, the wage-weighted aggregate employment increased by 3 per cent per annum, 1.6 percentage points higher than the increase in hour-weighted aggregate employment increased by only 1.4 per cent per annum. As labour contributed to about two third of GDP, the factor reallocation alone contributed to 1 percentage point in GDP growth.

10.2 Sectoral results (Table 5)

All sectors grew over the period (columns 10 and 11, Table 5). However, outputs of manufacturing sectors grew the fastest, at an average of 10.0 per cent per annum, followed by services (7.5 per cent per annum), and agriculture (6.4 per cent per annum). At the more disaggregated level, the fastest growing sectors were *metal products, chemicals, TCF, utilities*, *financial services, machinery and equipment,* and *tourism*. The slowest growing sectors include *public administration, health care, property and business services* and *hotels and restaurants*.

As can be expected, the exogenous changes which contributed the most to the growth of GDP also contributed the most to sectoral growth. Technical changes contributed the most to most of the sectors, followed by shifts in foreign demand and changes in the terms of trade. However, closer examination may reveal that some sectors benefited more from some groups of shocks than others. The discussion bellow focuses on the analysis of biggest winners and biggest losers in the period.

The sector which expanded the most during this period was *metal products*, which grew at an average of 15 per cent per annum. The sector gained most from the change in users' preferences toward domestically-produced metal products and away from competing imports. The second important factor for this sector was the improvement in technology.

The second fastest growing sector was *chemicals*. This sector also gained from technical change and the change in preference toward domestically-produced chemicals. In addition, it gained from favourable shift in household taste toward its products.

The third fastest growing sector was *textiles, clothing and footwear*. The factors which contributed the most to its growth were shifts in foreign demand, changes in technology and the increase in employment.

The sector which grew the slowest was *public administration*. This was due to the decline in the average propensity to consume and the decline in public consumption relative to private consumption. The main factor behind the decline in public administration is the

government effort to reduce the role of the sector in economic activity and to make it more efficient.

The second slowest growing sector was *Health care*. It benefited from changes in the trade environment, in technical changes and in employment growth, but the extent of the gains were smaller than in other sectors. The sector was adversely affected by the decline in the average propensity to consume, which caused private consumption to grow less than GNP.

At the more aggregate level, output of the *industrial* sector, which includes *mining, manufacturing and construction* industries, expanded the most, at 94.2 per cent (9.9 per cent per annum). Output of *services* grew 66.1 per cent (7.5 per cent per annum). Output of *agricultural* industries grew the least, only 54.8 per cent (6.4 per cent per annum).

Technical progress played the biggest positive role for all three broad sectors. Other factors with have positive effects on all three broad sectors included shifts in foreign demands, and the increase in employment. However, the *industrial* sector benefited much more than *agriculture* and *services* from those shocks. These three groups of shocks alone increased industry's output by 66.3 per cent, whereas they increased output of agriculture and services by 46.5 and 60.7 per cent respectively. The *industrial* sector also benefited from the change in household tastes, indirect taxes (including trade taxes), and I/K ratio, which increased the sector outputs by a further 28.7 percentage point. The sector only suffered a minor contraction (0.8 per cent) from the real appreciation effect of the increase in land supply.

On the other hand, the *agriculture sector* experienced a further smaller positive effect from the increase in land supply and in the changes in APC, which increased its output by 14.5 per cent. But its output declined by 6.2 per cent due to the effects of changes in household tastes, indirect taxes, and import/domestic preferences.

The *services* sector further benefited from the change in household tastes and from indirect taxes reform, but experienced adverse effects of the increase in land supply, import/domestic preference, and the decline in the average propensity to consume. As a result, its output did not expand as much as that of the industrial sector.

4. CONCLUSIONS

Between 1996 and 2003, the Vietnamese economy grew rapidly, recording annual average real GDP growth of 6.8 per cent. At the same time, it was subject to significant structural change. The composition of domestic absorption shifted towards investment and away from public and private consumption. The volume of trade grew almost twice as quickly as real GDP. Agriculture grew slowly, relative to manufacturing and services. The period coincided with a number of policy changes and external shocks. In this paper we impose neoclassical structure on these features of Vietnam's recent economic performance by undertaking a detailed historical and decomposition simulation with a CGE model of the Vietnamese economy. Consistent with the findings of other recent observers of Vietnam's economic success, our story also emphasises rapid GDP growth, export and investment growth, and structural change towards manufacturing. In our story, we find rapid growth in real GDP to be due to productivity and labour force growth. We trace rapid growth in

exports to technical change towards usage of more imports and productivity growth in export producing sectors. Our results downplay policy reforms (such as the introduction of the VAT and reductions in trade taxes) as important explanators of rapid growth in trade and GDP. At the same time, we recognise that Doi Moi policy reforms introduced prior to and during our study period were essential enablers of the high productivity growth occurring in our study period. We see our paper making four main contributions to the existing research on Vietnam's economic success. Firstly, our account carefully distinguishes cause and effect. Secondly, our account is quantitative and highly disaggregated. We quantify the individual impacts on observed economic variables of a large number of exogenous factors. Hence, observed outcomes for a large number of economic variables can be explained in terms of contributions made by these exogenous factors. Thirdly, we add to the list of factors which explain Vietnam's recent growth and change. These new factors include household taste changes, changes in foreign preferences, and growth in agricultural land supply. Fourthly, we consider all factors jointly, within a general equilibrium neoclassical system.

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[1] Fford (2001: 8-9), Dapice (2003a: 3-5), Shultz et al. (2006: 665-666), Binh and Long (2003).

[2] Fford (2001: 3), Dapice (2003: 3) and Pham Do Chi and Le Viet Duc (2003).

[3] Van Arkadie and Mallon (2003: 198-201).

[4] Kokko (1998: 325), Fford (2001: 15-16), Dapice (2003: 3) and Pham Do Chi and Le Viet Duc (2003).

[5] Dapice (2003: 5)

[6] Fford (2001: 3-4), Kokko (1998: 319).

[7] Dapice (2003), Shultz et al. (2006: 667-669).

[8] Shultz et al. (2006: 671-678), Fford (2001: 12-13).

[9] Van Arkadie and Mallon (2003: 122-175, 194-195, 259-260), Shultz et al. (2006), Pham and Le (2003), Dapice (2003).

[10] Van Arkadie and Mallon (2003: 255-256).

[11] Van Arkadie and Mallon (2003: 255-257).

[12] Van Arkadie and Mallon (2003: 181), Shultz et al. (2006: 657).

[13] Van Arkadie and Mallon (2003: 181-188).

[14] Van Arkadie and Mallon (2003: 210-214), Fford (2001: 10), Binh and Long (2003).

[15] Van Arkadie and Mallon (2003: 215-222), Tho (2003).

[16] Input-output data was provided by GSO (1999). Additional information on 1996 wages, capital stocks, sectoral investment, government finances, and balance of payments were obtained from the 1997 statistical year book (GSO 1998), the industrial survey (GSO 2000) and various reports by the International Monetary Fund (IMF 2000, 2003 and 2006a).

[17] Elasticities came from a number of sources. To date, there have been few Vietnam-specific estimates of CGE-relevant elasticities. Estimation of household expenditure elasticities is an exception, and we were able to obtain such elasticities for some agricultural and processed food products from ADB (1996), Goletti and Rich (1998), IFPRI (2002), Dey et al. (2004) and Schipper (2005). For the remaining commodities, GTAP household expenditure elasticities were obtained from Dimaranan (2006). MVN's household expenditure elasticities vary from about 0.8 for agriculture, through unity for most food and beverage products, to 2.5 for air travel. Commodity-specific export demand elasticities for Vietnamese goods were also estimated from Dimaranan (2006), by using the GTAP estimates for Armington elasticities and Vietnamese market shares. This produced a weighted-average export demand elasticity for Vietnam of -5, with sectoral elasticities varying from about -8 for crude oil and gas to about -2 for livestock. We use GTAP Armington elasticities in MVN. The weighted average Armington elasticity in MVN is about 3. For primary factors, we set the labour / capital substitution elasticity at 0.5. This is consistent with estimates by Ellis and Price (2003) and values in MONASH (Dixon and Rimmer 2002).

[18] The 93 industries are a slight aggregation of the 97 industries in the official 1996 input-output table (GSO 1999). For reporting, results for these 93 industries and commodities are aggregated to results for 22 sectors in Table 3.

[19] Based on the "sketch model" of Dixon and Rimmer (2002: 243).

[20] The origin of equation (5) is the identity NGNP = GDP P_{GDP} – NNFL R, where NGNP is nominal GNP, GDP is real GDP, P_{GDP} is the price of GDP, NNFL is nominal net foreign liabilities, and R is the interest rate on net foreign liabilities. Dividing through by P_C, the price of consumption, gives equation (5), where $F_2(TOT) = P_{GDP} / P_C$, and NFL = NNFL / P_C. The ratio P_{GDP} / P_C is a positive function of the terms of trade, because P_{GDP} contains export prices, while P_C does not.

[21] (E9) is based on the profit maximising first order condition that the value of the marginal product of capital equals the rental price of capital, noting that the production function is constant returns to scale. See Dixon and Rimmer 2002: 244.

[22] (E10) is based on the profit maximising first order condition that the value of the marginal product of labour equals the wage, noting that the production function is constant returns to scale.

[23] A fuller (but still simplified) description of the relevant MVN equation, of which (E11) is a stylised representation, is:

$$NFL_{t+\tau} = NFL_t + \sum_{s=0}^{\tau-1}[K_{t+s+1} - K_{t+s}(1-D)] - \sum_{s=0}^{\tau-1}[(1-APC_{t+s}) \cdot GNP_{t+s}]$$

where t is the initial year, τ is the solution year, D is the rate of depreciation and all other variables are as defined in the main text. See Dixon and Rimmer (2002:43-47) for details.

[24] The reader is referred to Dixon and Rimmer (2002:10-13) for a detailed discussion of these closures.

[25] The decomposition algorithm calculates an exogenous variable's contribution to the total movement in a given endogenous variable by summing its contributions as it moves along a path from its pre- to post-shock value. This requires, along this path, continuous re-evaluations of the endogenous variable's elasticity to the exogenous variable in question. These elasticities will be somewhat dependent on movements in other shocked variables. Hence, the effects of a given shock in a given column are largely, but not completely, independent of shocks in other columns. This is apparent in the results for private and public consumption (rows 3 and 5 of Table 2). The percentage change expression for BOTE equation 4 is $c - g = \gamma$. The effects of movements in Γ are identified in column 9, so $\gamma = 0$ in the other columns. Hence we expect $c = g$ in these columns. But since Γ falls over the period, this has a subtle effect on the contributions made to C and G in other columns. For example, in column 1 private consumption rises by 22.3 per cent but public consumption rises by only 20.7 per cent.

[26] Allowing the exogenous determination, at historically observed values, of employment by industry, output by commodity and the aggregate capital stock. See Dixon and Rimmer (2002: 250-259) for details.

[27] Since the base year shares of labour, capital and land in total factor income are 63.3, 25.5 and 11.2 per cent respectively, the rise in total factor productivity in column 1 is approximately 14.8 per cent [=16.7 – 0.633*(-1.1) - 0.255*9.9)]. This represents TFP growth of approximately 2 per cent per annum

[28] We are unsure if this result is plausible. One possibility is that it simply reflects discrepancies in GSO data, which may have overestimated movements in construction inputs relative to construction output. However another interpretation, consistent with contemporary public policy discussion, is that the result is correct and reflects a rise in waste. A large proportion of construction work is public investment in infrastructure. There is evidence that a significant part (20 -30 per cent) of public investment was wasted over the period due to inefficiency, poor planning, and corruption (see CIEM 2003, 2005, and Nguyen Khac Minh and Giang Thanh Long 2007).

[29] The remaining 3.5 percentage point are due to movements in the remaining technical change variables, namely: commodity-specific input-using technical change, cost-neutralising all-input-using technical change, industry-specific technical change in capital formation, and cost-neutral capital/labour bias in technical change.

[30] Note that a sector's contribution to GDP in this column depends both on its technical change and its share in GDP. As a result, although *financial services* experienced the largest improvement in technology, the sector's contribution to real GDP growth is lower than agriculture and mining – sectors with higher shares in GDP in the base year 1996.

[31] See endnote 28.

[32] The historical simulation infers this sector's change in primary factor technology given exogenously imposed *trade and repairs* output growth of about 60 per cent and exogenously imposed growth in *trade and repairs* labour and capital usage of 92 per cent and 148 per cent respectively.

[33] In presenting decomposition simulation results, one option would be to present three columns of trade-related results, that is, one column for each of shifts in foreign demand, export mark-ups, and import prices. We aggregate these in column (2) because we think these effects should be considered jointly. This is so for two reasons. Firstly, shifts in foreign demands and import prices will be similarly affected by changes in world economic conditions. Secondly, movements in mark-ups can be interpreted as the effects of partial Vietnamese adjustment to changes in foreign demand for Vietnamese exports.

[34] Had demand for Vietnamese exports simply grew with world GDP at the rate of 3.7 per cent per annum (IMF 2006b), the horizontal shift in Vietnamese export demand schedules would have been of the order of 30 per cent. At an average export demand elasticity of 5, this is equivalent to a 6 per cent increase in $f_i^{(X)}$.

[35] For a detailed discussion of changes in Vietnam's trade regime, see CIE (1998), Authukorala (2005), and USTR (2004).

[36] Note, however, that a number of goods and services are exempted from VAT, and thus enterprises would not be able to claim VAT on the intermediate inputs used to produce them. The goods and services include raw agricultural materials, health and education services, public broadcasting, cultural events, sanitation works, and goods which are subject to special consumption tax (such as alcoholic beverages, tobacco products, and assembled motor vehicles).

[37] The 20 per cent rate has been removed from 1 January 2004 (VN National Assembly 2003).

[38] The composition of domestic and imported commodities in government demand is assumed to be exogenous.