

Technical Appendices to:
East Asian Growth Experience Revisited from the Perspective of a Neoclassical Model

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Technical Appendix A: The Model for Business Cycle Accounting Methodology

In this section, I describe the model used for the business cycle accounting methodology applied in the paper.

A.1. The economy

The economy of the model is composed of a representative household and producers in an environment characterized by perfect foresight. Individuals may face shocks but the shocks last for only one period.

A.1.1. The representative household

There is an infinitely lived representative household with working-age population N_t at time t . The size of the household grows at an exogenous rate, i.e., $N_t = (1 + v_t)N_{t-1}$.

Agents value leisure. There is one unit of labor available in each period. The utility function is:

$$\sum_{t=0}^{\infty} \beta^t N_t \{ \log(c_t) + \phi \log(1 - l_t) \},$$

where $c_t \equiv \frac{C_t}{N_t}$ is consumption per working-age person, and $l_t \equiv \frac{L_t}{N_t}$ is labor hours per working-age person. β is the discount factor and ϕ is the coefficient for leisure in the agent's utility. The period budget constraint for the household is:

$$C_t + I_t = w_t L_t + r_t K_t,$$

where $I_t \equiv N_t i_t$ is investment, w_t is wage rate and r_t is the rental price for capital. Moreover, $K_t \equiv N_t k_t$ is capital. Capital evolves over time following the law of motion (A.1)

$$N_{t+1} k_{t+1} = [(1 - \delta)k_t + i_t] N_t, \quad (\text{A.1})$$

where δ is the depreciation rate.

The first-order conditions for (l_t, k_{t+1}) are:

$$\frac{w_t}{c_t} = \frac{\phi}{1 - l_t}, \quad (\text{A.2})$$

$$\frac{c_{t+1}}{c_t} = \beta \cdot (1 + r_{t+1} - \delta). \quad (\text{A.3})$$

A.1.2. Production sector

Firms in this economy adopt the Cobb-Douglas production that includes labor-augmenting technology progress (x_t) . x_t grows at the constant rate γ . For a single firm,

$$\tilde{y}_t = \tilde{k}_t^\theta (x_t \tilde{l}_t)^{1-\theta}, \quad x_t = (1 + \gamma)^t x_0,$$

where $\tilde{y}_t$ is output, $\tilde{k}_t$ is capital input, $\tilde{l}_t$ is labor input, at each date. In addition, θ is capital share. Based on the property of the Cobb-Douglas production function, the production technology for the whole sector is:

$$Y_t = K_t^\theta (x_t L_t)^{1-\theta}. \quad (\text{A.4})$$

In equation (A.4), Y_t is aggregate output, K_t is aggregate capital input, and L_t is aggregate labor input at each date. The first order conditions, which equate the marginal product of factors to factor prices for firms are:

$$r_t = \theta \frac{Y_t}{K_t}, \quad (\text{A.5})$$

$$w_t = (1 - \theta) \frac{Y_t}{L_t}. \quad (\text{A.6})$$

A.1.3. Market equilibrium

In equilibrium, goods can be consumed or invested. There are two factor-markets in this economy, i.e., capital and labor markets. The capital market clears at price r_t and the labor market clears at wage w_t . Thus, capital and labor supplied by the representative household equate those demanded by firms. Therefore, the equilibrium conditions are as follows:

$$C_t + I_t = Y_t \equiv N_t y_t, \quad (\text{A.7})$$

$$N_t k_t = K_t, \quad (\text{A.8})$$

$$N_t l_t = L_t. \quad (\text{A.9})$$

A competitive equilibrium for an undistorted system given the initial capital stock K_0 , the population N_t and a sequence of quantities $\{Y_t, C_t, I_t, K_t, L_t, k_t, l_t\}_{t=0}^\infty$, and a sequence of prices $\{w_t, r_t\}_{t=0}^\infty$ satisfies the following conditions: (a) the representative family's first-order conditions (A.2) and (A.3); (b) the firm's production function (A.4) and first-order conditions (A.5) and (A.6); (c) the market-clearing conditions (A.7), (A.8) and (A.9); (d) law of motions (A.1); such that the representative household maximizes its utility and firms optimize their production and markets clear.

A.2. Solving the model

Given the labor-augmented technology, which grows at the rate γ , I detrend all the variables by $(1 + \gamma)^t$. Thus, the stationary version of the model as a competitive equilibrium is presented below after defining the detrended variables for per working-age person as follows:

$$\hat{y}_t = \frac{y_t}{(1 + \gamma)^t}; \quad \hat{c}_t = \frac{c_t}{(1 + \gamma)^t}; \quad \hat{i}_t = \frac{i_t}{(1 + \gamma)^t}; \quad \hat{k}_t = \frac{k_t}{(1 + \gamma)^t};$$

The equilibrium conditions (a)–(d) in section A.1.3 above can be reduced to the following system of equations (Eqs. A.10 to A.14) that characterize the equilibrium in terms of the detrended variables as follows:

$$\hat{y}_t = \hat{k}_t^\theta (x_0 l_t)^{1-\theta}, \quad (\text{A.10})$$

$$\hat{c}_t + \hat{i}_t = \hat{y}_t, \quad (\text{A.11})$$

$$(1-\theta) \frac{\hat{y}_t}{l_t} = \frac{\hat{c}_t \phi}{(1-l_t)}, \quad (\text{A.12})$$

$$\{(1+\gamma) \frac{\hat{c}_{t+1}}{\hat{c}_t \cdot \beta}\} = 1 + \theta \frac{\hat{y}_{t+1}}{\hat{k}_{t+1}} - \delta, \quad (\text{A.13})$$

$$(1+v_{t+1})(1+\gamma)\hat{k}_{t+1} = (1-\delta)\hat{k}_t + \hat{i}_t. \quad (\text{A.14})$$

The system of equations (A.10–A.14) has 5 equations and 5 unknowns. The system expresses the equilibrium conditions of the economy.

Technical Appendix B: Variable Descriptions and Data Sources

B.1. Variable descriptions

The data used are as follows: output (Y), consumption (C), labor input (L), investment (I), initial capital stock in 1966 (K_0), and population of working age (N). I chose Gross Domestic Product (GDP) as my base value for output (Y) since the economic shocks generally affect an economy according to geographical regions rather than being based on national boundaries. Moreover, I exclude net indirect tax from GDP as Y since taxes are not payments for factor inputs. I chose private consumption as the value for C , gross fixed capital formation as the value for I , annual total labor hours divided by 3600—time endowment per person—as the value for L and the working-age population (15–64) as the value for N (except for the U.S. I use the population aged 16–64). I convert all the nominal variables into real ones by using the GDP deflator. In addition, all the variables, which are included in the simulation, are divided by N .

To estimate the capital stock (K), I use the perpetual inventory approach for the sub-categories of fixed capital formation (i.e., residential buildings, nonresidential buildings, other construction, transportation equipment, and machinery equipment) and adopt the sub-category depreciation rate (δ_i) assumed in Hsieh (2002), which is the same as those rates adopted in Young (1992): 1.3% for residential buildings, 2.9% for nonresidential buildings, 2.1% for other construction, 18.2% for transportation equipment, and 13.8% for machinery equipment. To estimate the initial capital stock under each category ($K_{i,0}$), I use the equation: $K_{i,0} = \frac{I_{i,0}}{(\delta_i + \gamma_i)}$. To avoid random bias, $I_{i,0}$ is the

average of real gross fixed capital formation of each sub-category i for the first five years for which data were available. Moreover, γ_i is the geometric average of the growth rate for investment in each sub-category i over the first five years of data. Since the time series for gross fixed capital formation for Hong Kong is available from 1961,

for Singapore from 1960, for South Korea from 1953¹ and for Taiwan from 1951, and this study focuses on the period that begins in 1966, I am allowed to have 5 to 15 years of the estimated capital stock data before I begin to adopt the value for the initial capital stock. Given positive depreciation rates, my estimated initial capital stocks are insensitive to the assumption of $K_{i,0}$. (This is a widely accepted approach to estimate capital stock in the literature.) Subsequently, I use the law of motion to estimate the capital stock for each subcategory, add them up, and obtain the time series for capital stock. Then, I re-estimate the time series of capital stock by using a country-specific depreciation, which is chosen such that given the capital stock in 1966 and the time series for the aggregate investment of each country, the constructed capital stock to output ratio of 2006 matches that estimated using the investment data of subcategories.

To estimate human capital stock, i.e., quality of labor (h), I obtain the average years of schooling for the population aged 15 and over (estimated by Barro and Lee, 2001) because I focus on working-age population, which refers to the population aged 15–64. Since the data is quinquennial, I follow Hall and Jones (1999), Caselli (2005), and Klenow and Rodriguez-Clare (2005) and use linear interpolation for the years between data points and assume that the annual increment between 2000 to 2006 remains the same as that between 1999 to 2000.² Therefore, h is measured by the following formula:

$$h = e^{\phi(s)}, \quad \phi(s) = \begin{cases} 0.134 \cdot s & \text{if } s \leq 4 \\ 0.134 \cdot 4 + 0.101 \cdot (s - 4) & \text{if } 4 < s \leq 8, \\ 0.134 \cdot 4 + 0.101 \cdot 4 + 0.068 \cdot (s - 8) & \text{if } 8 < s \end{cases}$$

where s is the average years of schooling, and $\phi(s)$ is a piecewise linear function, which is used in the literature to take care of the log-linearity and concavity of the education-wage (and thus education-labor quality) relationship in the international data.

Finally, I convert all the time series of Y , C , I , and K to international dollars constant at 2005. First, I use the ratios of my GDP data versus those in the Penn World Table (PWT) in 2005 to obtain the exchange rate and convert Y in 2005 into international dollars constant at 2005. Then, I compute the growth rate of Y , the ratios of K/Y , I/Y , and C/Y based on the data obtained from local governments' statistics sources, which are in units of local currency and deflated using the GDP deflator. Finally, I use the growth rate of Y and the computed ratios to construct the time series used in the simulation.

B.2. Data sources

For most variables, I download the data mainly from governments' webpages and supplement with Datastream, the Penn World Table (PWT) 6.3, International Financial Statistics (IFS), the World Development Indicator (WDI),

¹ Since the Korean War ended in 1953, I use investment data starting from 1958 (instead of 1953) to estimate the initial capital stock of 1966. This is equivalent to adjusting downward the estimated aggregate capital stock in 1953 by 25.5% to take into account the destruction from war.

² Since human capital does not change dramatically, the observation "can plausibly be employed for nearby dates" (Caselli, 2005).

and printed versions of statistical books, which are used to extend the series back to the 1960s. For data related to the national accounts, the upper level data (e.g., aggregated GDP, gross fixed capital formation) are usually available since the 1960s in a single source. However, the data for subcategories (e.g., net indirect tax, gross fixed capital formation in residential buildings, nonresidential buildings, other construction, transportation equipment and machinery equipment) usually need to be consolidated from different sources. Thus, the first principle for consolidating the series from different statistical books is to assume that the ratios (e.g., the particular series to GDP ratios) in the statistical books are correct and use those ratios and the time series from a single database to come up with the extended series. The second principle is that if the data in different statistical books are different, I assume that the more recent version is correct.

The values of total labor hours are obtained from the Total Economy Database (TED), which provides labor hour statistics for Hong Kong from 1950, for Singapore and Taiwan from 1960, for South Korea from 1963, and for the U.S. from 1950. In addition, since the hours per worker data used in the TED are derived from interpolation for Hong Kong, Singapore, and South Korea, I substitute their data with those from the International Labor Organization (ILO)/yearbooks whenever they are available. To consolidate the gap between the time series from different sources, I use the first five years for which data from the TED and ILO/yearbooks overlap and compute the average ratios of data from the ILO/yearbooks to data from the TED. Then, I multiply that ratio to the data from the TED to have a smooth joining together of the series from different databases. For Hong Kong, the data from the ILO begin in 1987 and the ratio used to adjust the data from the TED is 1.0474. For South Korea, the data from the ILO begin in 1970 and the ratio used to adjust the data from the TED is 1.1095. For Singapore, the data from the ILO begin in 1982 and those from the *Singapore Yearbook of Labour Statistics* (issues of 1978, 1982, and 1989) begin in 1972. Since the numbers from these two sources are the same when data overlap, I use the data from the yearbooks to extend the ILO data back to 1972. Then I use the ratio 0.9863 to adjust the data from the TED and come up the labor hour series for Singapore.

For the rest of the variables, most of the data for the U.S. are from the Bureau of Economic Analysis, except the data for working-age population, which are obtained from Cociuba, Prescott, and Ueberfeldt (2009). I describe the detailed data sources for Hong Kong, Singapore, South Korea and Taiwan as follows:

The following series for Hong Kong are downloaded and requested from the Census and Statistics Department, Hong Kong: Gross Domestic Product at market price (1961–2006), private consumption (1961–2006), the GDP deflator (1961–2006), indirect tax (1980–2006), government expenditure (1961–2006), gross fixed capital formation and its subcategories (except transportation equipment) (1966–2006), and population by age group (1961–2006). To estimate the series of the fixed capital formation for transportation equipment, I obtain the gross fixed capital formation from the WDI (1960–2006) and subtract the other four series (residential buildings, nonresidential buildings, other construction, and machinery and other equipment) from it. To obtain the time series for working-age population, I add up the time series for working-age population by age group (15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, and 60–64). Moreover, following the first and second principle for data

construction, I construct indirect tax (1961–1979) based on data from three statistical books: *Estimates of Gross Domestic Product 1961–1975* (for 1961–1965), *Estimates of Gross Domestic Product 1966–1978* (for 1966–1973), and *Estimates of Gross Domestic Product 1966–1984* (for 1974–1979). Moreover, I construct the subcategories of investment series (1961–1965) based on the *Estimates of Gross Domestic Product 1961–1975*.

The following time series for Singapore are downloaded from Datastream: Gross Domestic Product at market prices (1960–2006) and private consumption (1960–2006). I purchased the following time series from SingStat Time Series (STS) online on Statistics Singapore: the GDP deflator (1960–2006), indirect tax (1980–2006), population by age group (1961–2006), government expenditure (1960–2006), Exports (1960–2006), Imports (1960–2006) and gross fixed capital formation and its subcategories (1960–2006). Moreover, the time series for working-age population (1961–2006) is derived from adding up the population of residents by age group (15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, and 60–64). Moreover, I obtain the time series of indirect tax (1960–1979) from *Economic & Social Statistics Singapore 1960–1982*. Since the time series from 1980–1981 in the statistical book are the same as those obtained from STS, I simply merge the data from these two sources.

The following time series for South Korea are downloaded from Economic Statistics System (ECOS) provided by Bank of Korea: Gross Domestic Product at market prices (1970–2006), private consumption (1970–2006), the GDP deflator (1970–2006), indirect tax (1970–2006), and gross fixed capital formation and its subcategories (1970–2006). In addition, the time series for working-age population (1961–2006) is derived from adding up the projected population by age group (15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, and 60–64), downloaded from Korean Statistical Information Service (KOSIS), provided by the Korea National Statistical Office. I also downloaded the time series for Gross Domestic Product (1953–2006), GDP deflator (1953–2006), government expenditure (1953–2006), Exports (1953–2006) and Imports (1953–2006) and gross fixed capital formation (1953–2006) from International Financial Statistics (IFS). To consolidate the time series from IFS and ECOS, I chose the data from the ECOS as the primary source and supplement them with the data from IFS. I merge the data from IFS (1953–1969) with those from ECOS (1970–2006) because the two series are identical from 1993–2006. Moreover, following the first and second principle, I construct the time series (1953–1969)—the subcategories of gross fixed capital formation, private consumption, indirect tax—based on the statistics in two statistical books: *Economic Statistics Yearbook 1971* (for 1953–1957) and *Economic Statistics Yearbook 1978* (for 1958–1969).

The following time series for Taiwan are downloaded from National Statistics, R.O.C, which are under the webpage for the Statistical Abstract of National Income: Gross Domestic Product (GDP) at market prices (1951–2006), private consumption (1951–2006), the GDP deflator (1951–2006), indirect tax (1951–2006), government expenditures (1951–2006), Exports (1951–2006), Imports (1951–2006), and gross fixed capital formation and its subcategories (1951–2006). Moreover, the time series for working-age population (1961–2006) are derived from adding up the civilian population by age group (15–24, 25–44, and 45–64), and were purchased from the Taiwan Economic Data Center.

Technical Appendix C: Supplemental Graphs (not reported in the paper)

I show the graphs for wedges (section C.1), output (section C.2), and capital and labor (section C.3). The results of these graphs are discussed in the main text, but the graphs are not shown there.

C.1. Figures for wedges: Figs. C-1 and C-2

Figures C-1 and C-2 show the computed wedges. The wedges in Fig. C-1 are derived by setting the terminal condition γ equal to 0. The wedges displayed in Fig. 2 of the main text are the trends of those displayed in Fig. C-1 filtering out business cycles using the Hodrick-Prescott filter with a smoothing parameter equal to 6.25. Figure C-2 also shows the computed wedges, but they are derived by setting the terminal condition γ equal to 2%. The wedges plotted in Fig. C-2 are the wedges used for generating the simulation results in section 5 of the main text.

Comparing the wedges in Fig. C-1 and Fig. C-2, I find them the same except that the TFP is flatter in Fig. C-2 than in Fig. C-1. Despite that, both figures show that the total factor productivity (TFP) of these NICs has grown faster than that of the U.S.

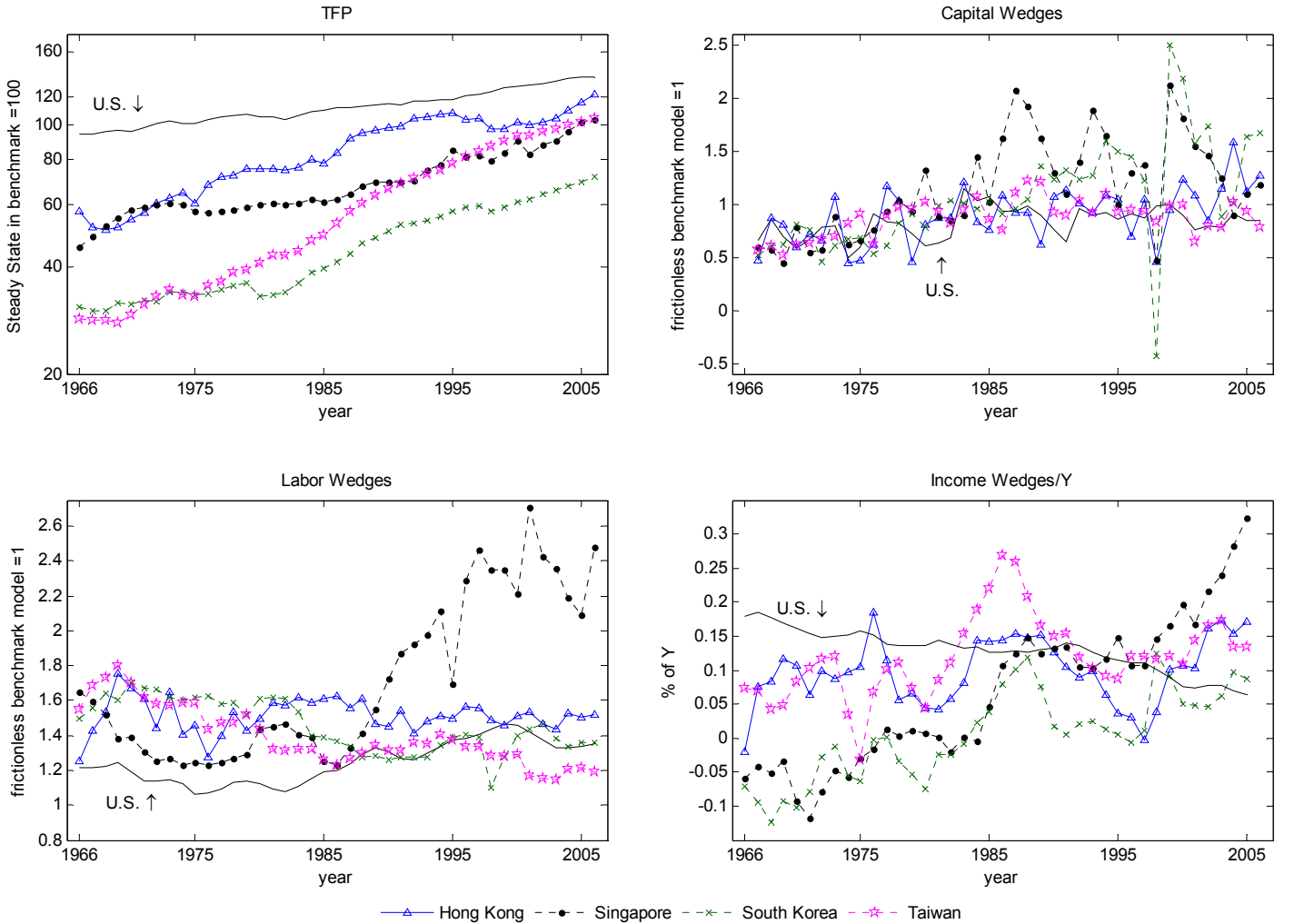


Figure C-1: (Baseline case, without smoothing) Wedges for Hong Kong, Singapore, South Korea, and Taiwan versus those for the U.S. (with terminal condition $\gamma = 0$).

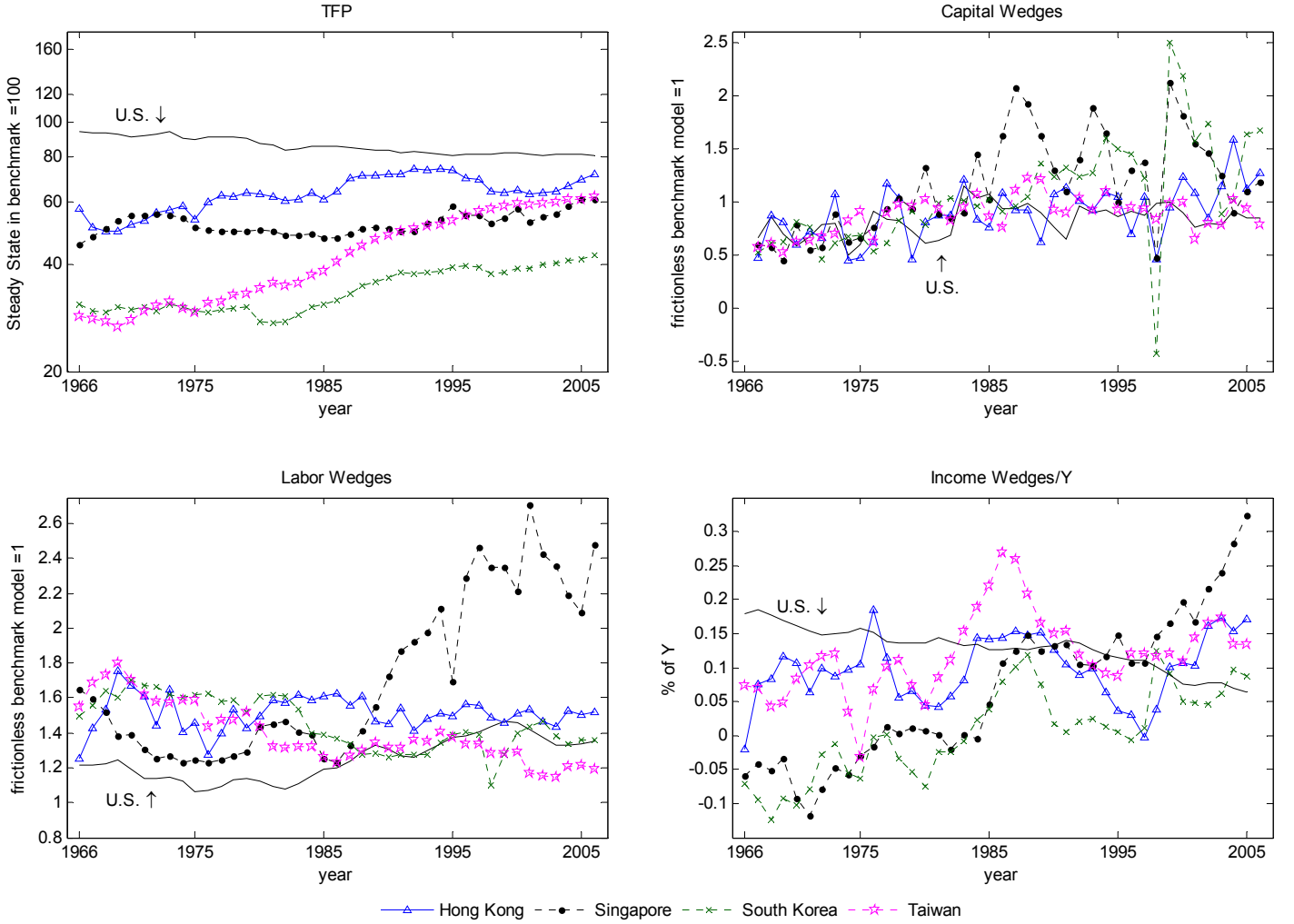


Figure C-2: (Baseline case, without smoothing) Wedges for Hong Kong, Singapore, South Korea, and Taiwan versus those for the U.S. (with terminal condition $\gamma = 2\%$).

C.2. Figures related to the discussion on output growth

In this section, I first show the figure that illustrates how each wedge contributes to output growth by the model with a single wedge. This is a complementary view to clearly show how each wedge by itself contributes to output growth. Then I show the graphs that are not shown in the main text but the results of which are discussed in section 5.1—discussion on output growth—of the paper. These graphs confirm the main result, that capital wedges tend to be important to output growth in the earlier stages of development and TFP growth tends to be important in the later stages of development.

C.2.1. A figure for output per working-age person (Y/N): Fig. C-3

Figure C-3 shows the transition dynamics of Y/N generated by the model with a single wedge for each country. By identifying the path most parallel to the data, I can pinpoint the primary wedge contributing to the output growth. For much of each graph, especially on the left half of the sample period, the path most parallel to the data is that

generated by the model with the capital wedge alone. This is true especially in Singapore, South Korea, and Taiwan. However, on the right half of each graph, the most parallel path is obviously that generated by the model with TFP only. This is true especially in Hong Kong, South Korea, and Taiwan. The particular parallel periods are different for the four countries, but the positions on the left or right half—the earlier or later stages—are consistent. Singapore has one clear distinction: for some extended time in the later stages, the path generated by the model with the income wedge only also nicely parallels the data.

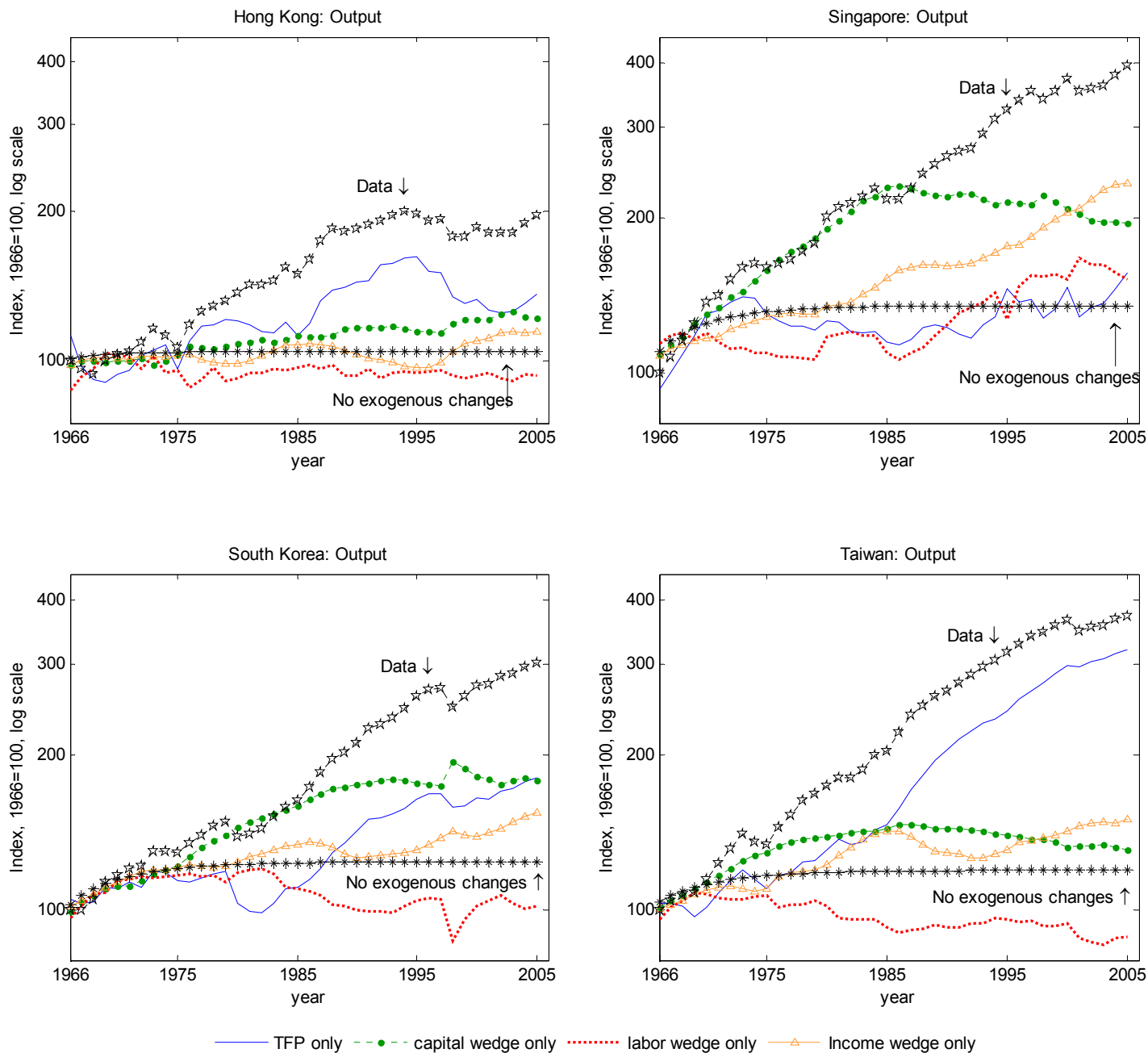


Figure C-3: (Baseline case: Y/N , detrended.) The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

C.2.2. Figures related to the discussion on human capital: Figs. C-4 to C-6

Figure C-4 shows the paths of TFP derived from the baseline model, i.e., “broad TFP” versus those from the model taking into account human capital, i.e., “pure TFP.” As can be seen, the model that takes into account human capital results in smaller TFP growth in general, especially in the late 1970s for Hong Kong, and in the 1970s for South Korea and Taiwan.

Figure C-5 (which is constructed similarly to Fig. 3 in the main text) shows the trajectories of Y/N from the model “without pure TFP.” As can be seen, for comparison with Fig. 3 in the main text, “pure TFP” growth is still important for sustained growth, especially in the later stages of development. It is because growth would have slowed had there been no growth of pure TFP.

Figure C-6 (which is constructed similarly to Fig. 5 in the main text) shows the trajectories of Y/N from the model sequentially adding in the capital wedge, human capital, pure TFP, the labor wedge, and the income wedge (in the order similar to Fig. 5 in the main text). Compared with Fig. 5 in the main text, I find that the contribution of broad TFP to growth before the early 1980s is due to human capital accumulation. Thus, the main result still holds when TFP is redefined as net of the effect of human capital, or “pure TFP.”

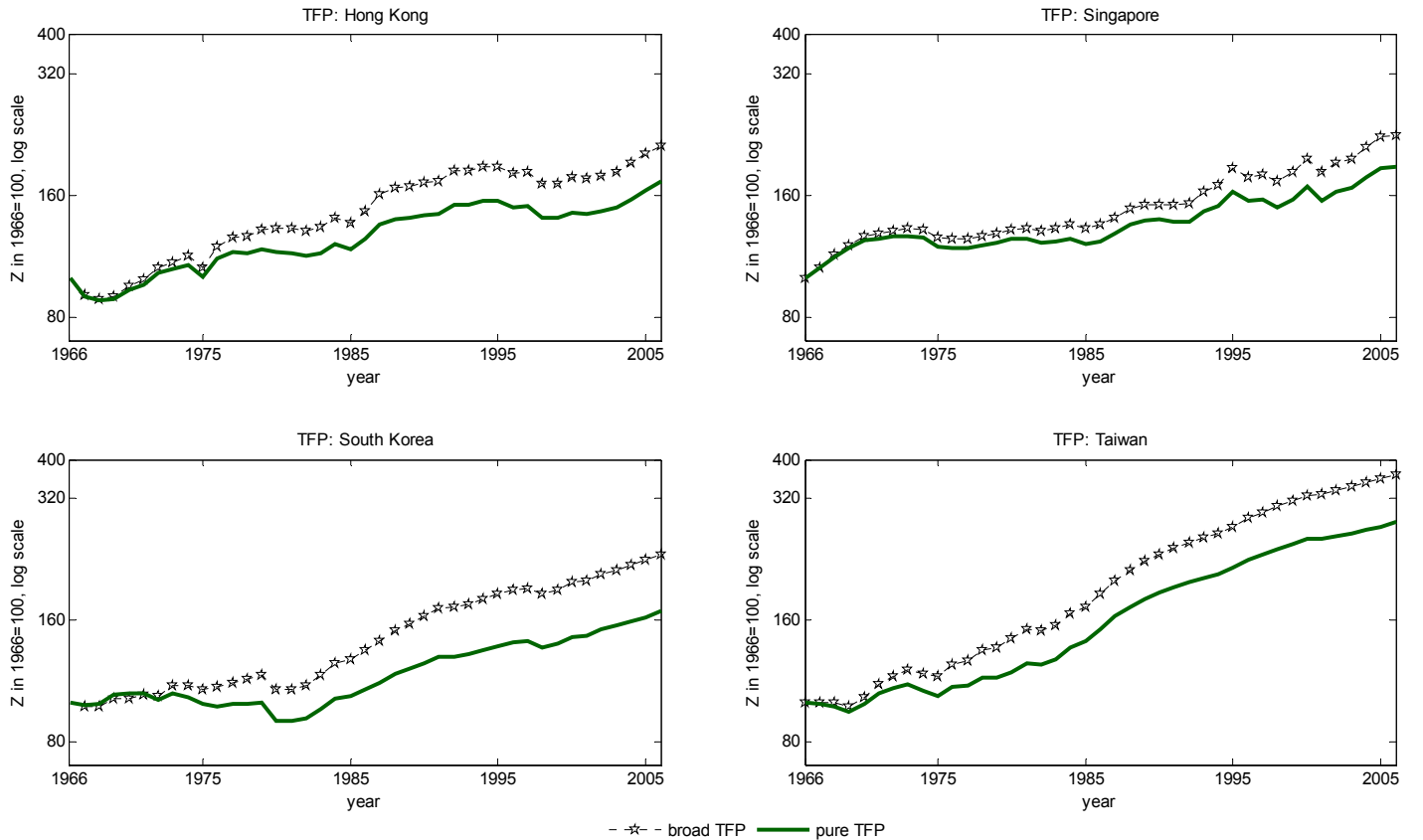


Figure C-4: The TFP from the baseline model (broad TFP) versus that from the model taking into account human capital (pure TFP), both with terminal condition $\gamma = 0$.

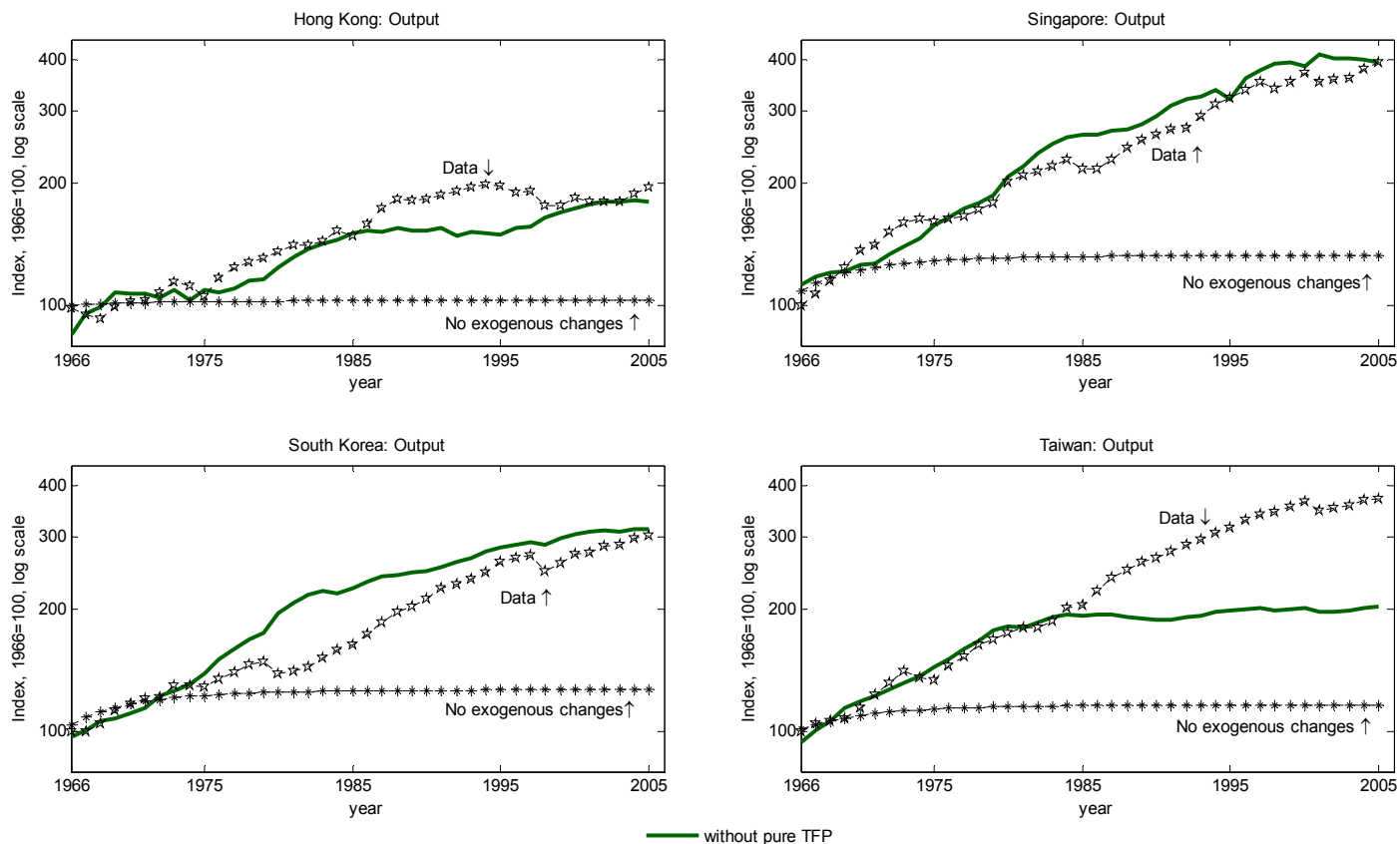


Figure C-5: (Considering human capital stock: Y/N , detrended.) The trajectories from the model with all wedge but pure TFP (i.e., without pure TFP) versus those from the model with no exogenous changes and data (the model with four wedges).

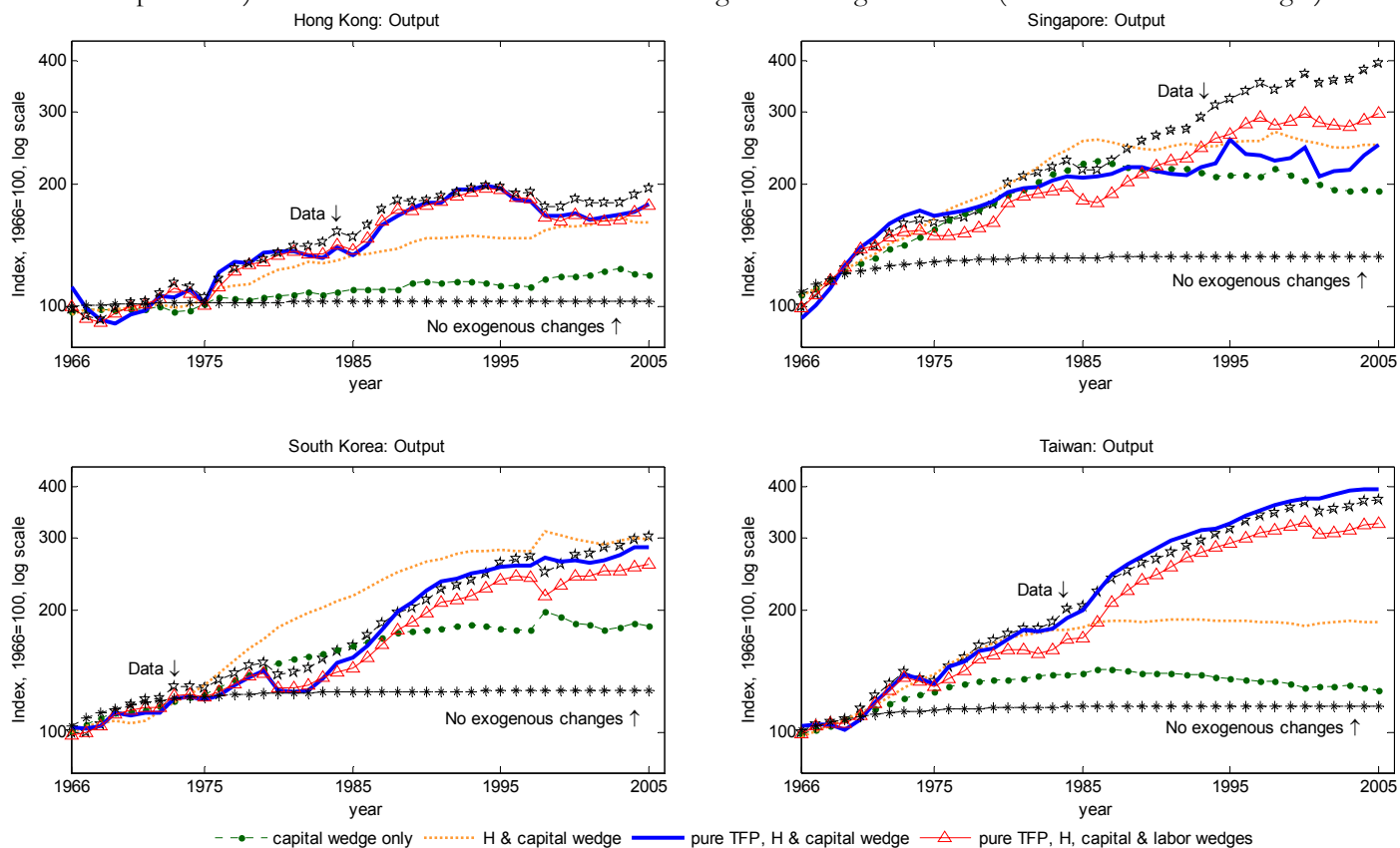


Figure C-6: (Considering human capital stock: Y/N , detrended.) The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, human capital (H), pure TFP, the labor wedge and the income wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

C.3. Figures related to the discussion on investment and labor growth

In this section, I show the figures whose results are discussed in section 5.2 of the main text—on investment and labor growth—but which themselves are not shown in the paper. These graphs show that much of the variables' growth—that relates to investment and labor—is explained by the capital wedge in the earlier stages of development and by TFP in the later stages. Moreover, similar to the discussion on output growth in the main text, I show graphs that further simplified the data period into earlier and later stages of development by arbitrarily choosing 1985 as the demarcation point. Though some results are then somewhat different from this perspective, it is, again, just the consequence of the arbitrary break in data.

C.3.1. Figures for investment-to-output ratio (I/Y) and Investment: Figs. C-7 and C-8

Figure C-7 shows the transition dynamics of I/Y from the model with one wedge only. This is the complete version of Fig. 6 in the main text. As can be seen, the model with “capital wedge only” can replicate the high I/Y , especially in the earlier stages of development. Thus, the model needs rising capital wedges to replicate the high I/Y in these NICs.

Figure C-8 (which is constructed similarly to Fig. 5 in the main text) shows the transition dynamics of investment (I/N , detrended) when sequentially adding in the capital wedge, TFP, the income wedge and the labor wedge (in the order they are first shown to be important in the data). As can be seen, the model with the capital wedge plus TFP captures the transition dynamics of investment, but the model with TFP, the capital wedge, and the income wedges allows the path to fit the data better.

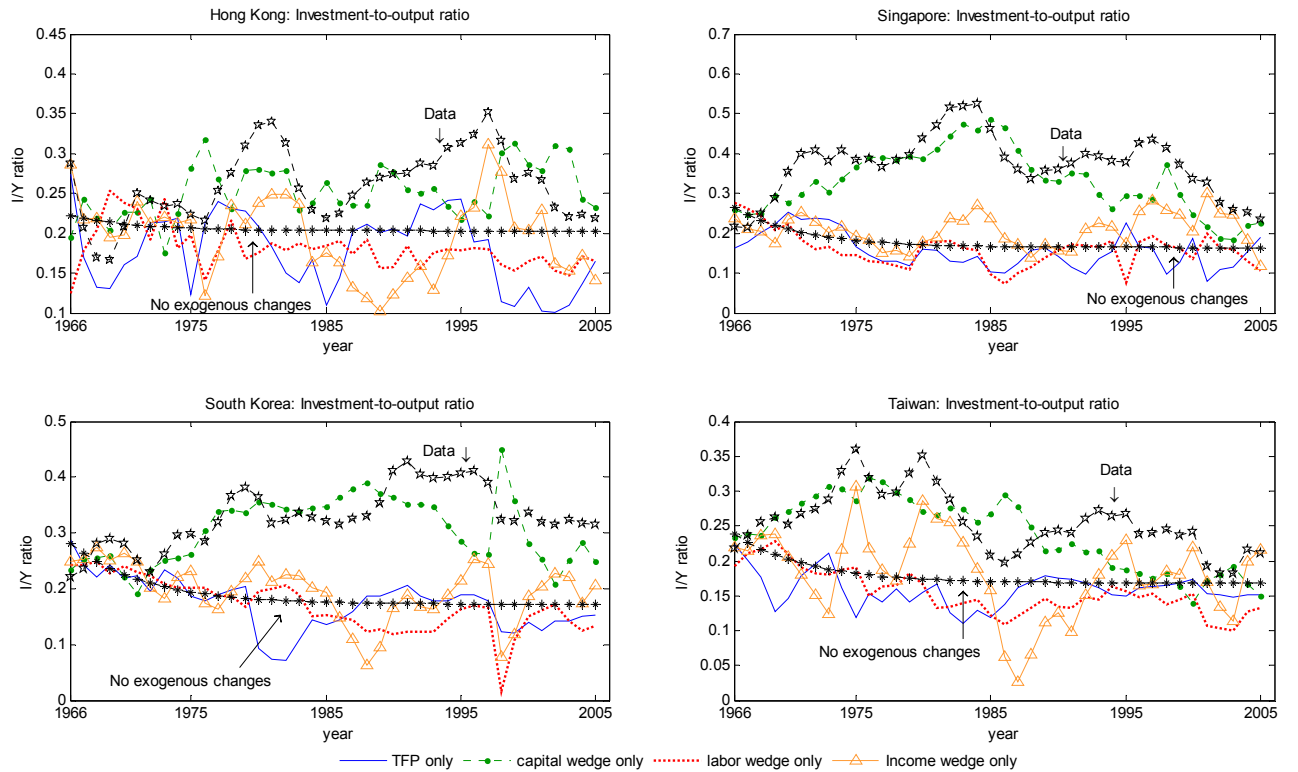


Figure C-7: (Baseline case: I/Y): The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

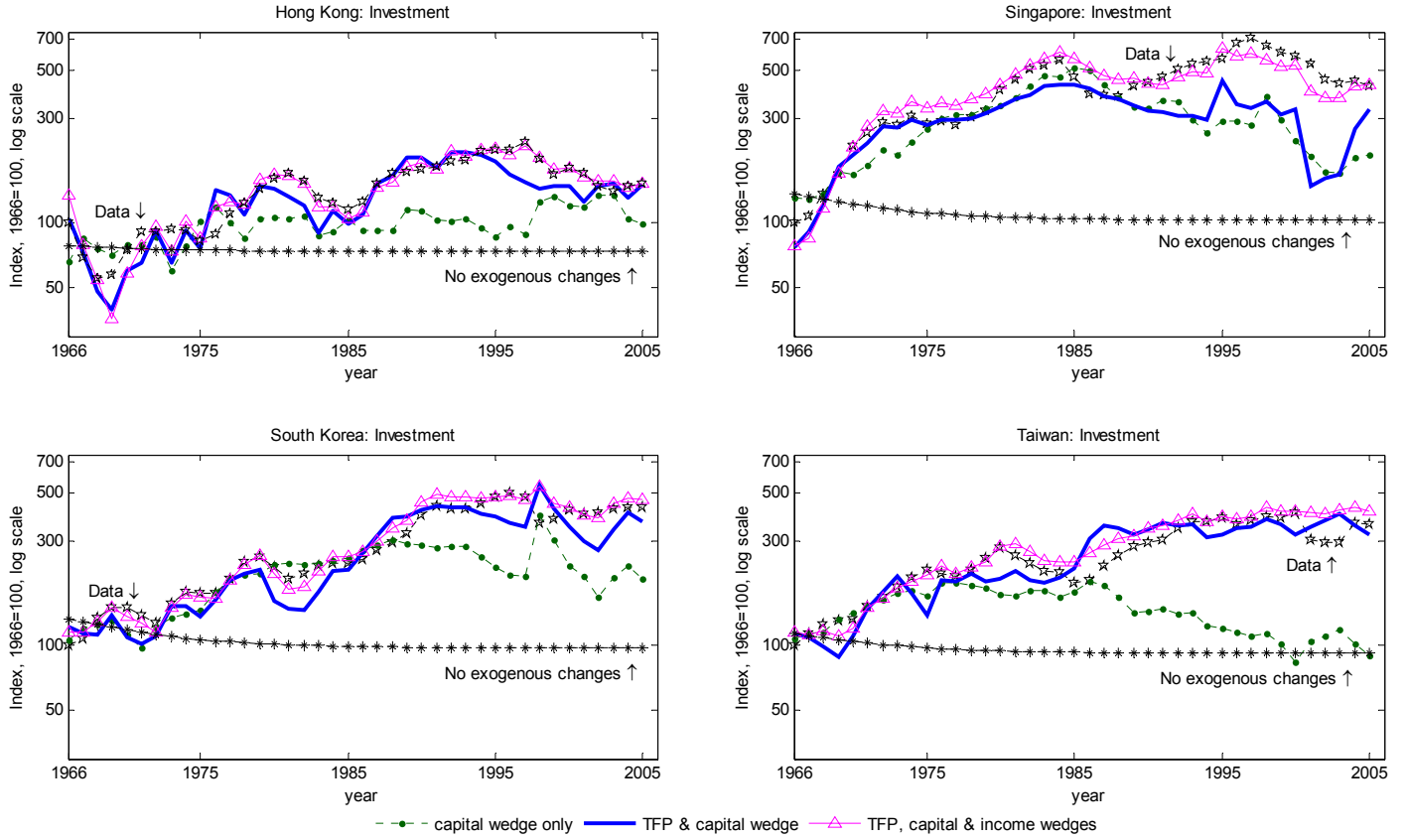


Figure C-8: (Baseline case: I/N , detrended.) The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, TFP, the income wedge and the labor wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

C.3.2. Figures for hours worked per working-age person (L/N): Figs. C-9 and C-10

Figure C-9 (which is constructed similarly to Fig. C-3) shows the transition dynamics of L/N from the model with one wedge only. As can be seen, the rising L/N is driven mainly by the capital wedge in the earlier stages (for all except Hong Kong), and then mainly by the income wedge in the later stages. Moreover, the labor wedge also positively contributes to the rising L/N , especially in the late 1960s and between the late 1970s and early 1980s in Hong Kong, from the late 1980s to 2000 in Singapore, and in the late 1960s for both South Korea and Taiwan.

Figure C-10 (which is constructed similarly to Fig. 5 in the main text) shows the transition dynamics of L/N when sequentially adding in the labor wedge, the capital wedge, the income wedge and TFP (in the order they are first shown to be important in the data). As can be seen, the model with labor, capital, and income wedges replicates most of the growth dynamics.³ Thus, the labor wedge (especially for Hong Kong), the capital wedge and then the income wedge stimulate the labor boom.

³ For Taiwan and Hong Kong, the model without TFP (i.e., the model with labor, capital and income wedges) results in higher growth in work effort than that shown by the data.

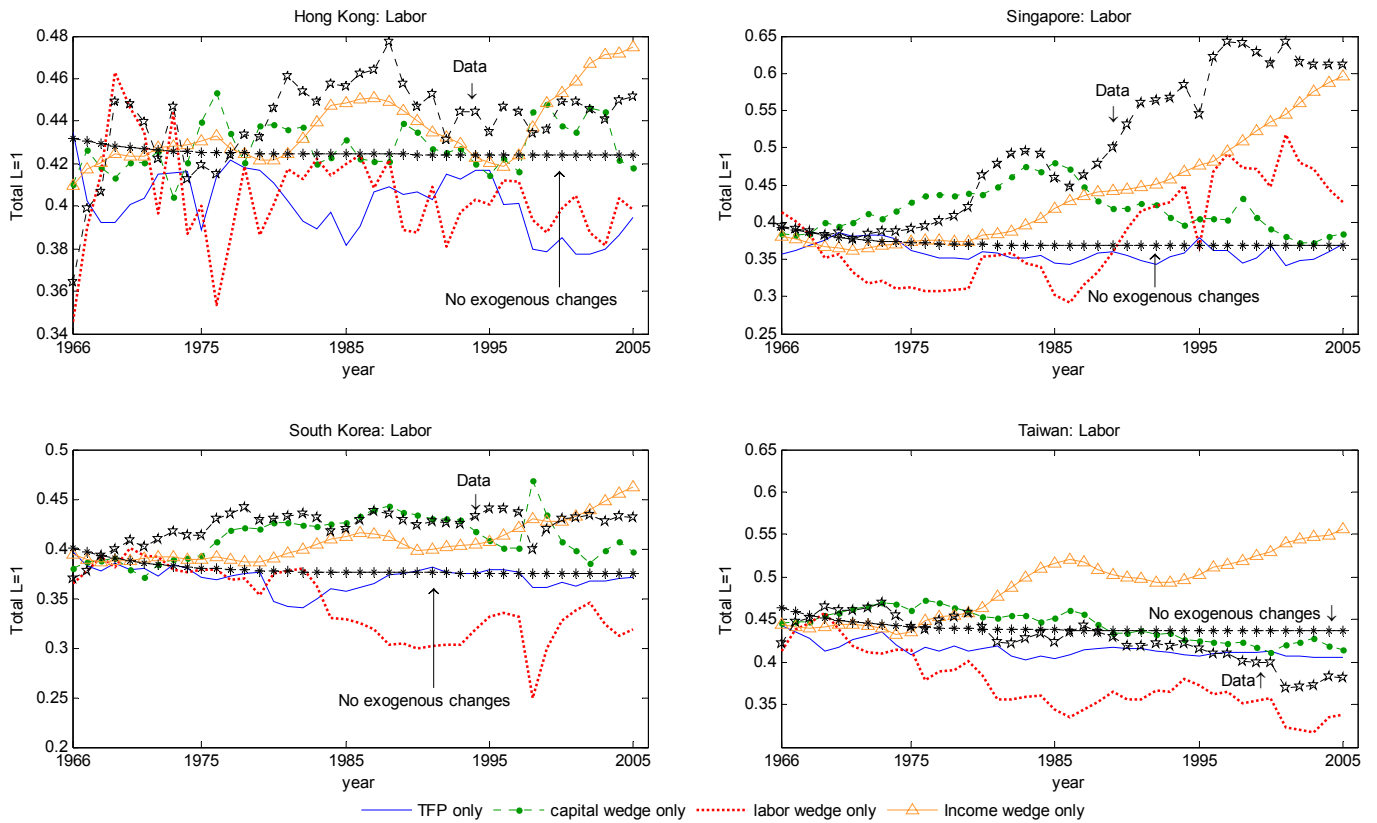


Figure C-9: (Baseline case: L/N) The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

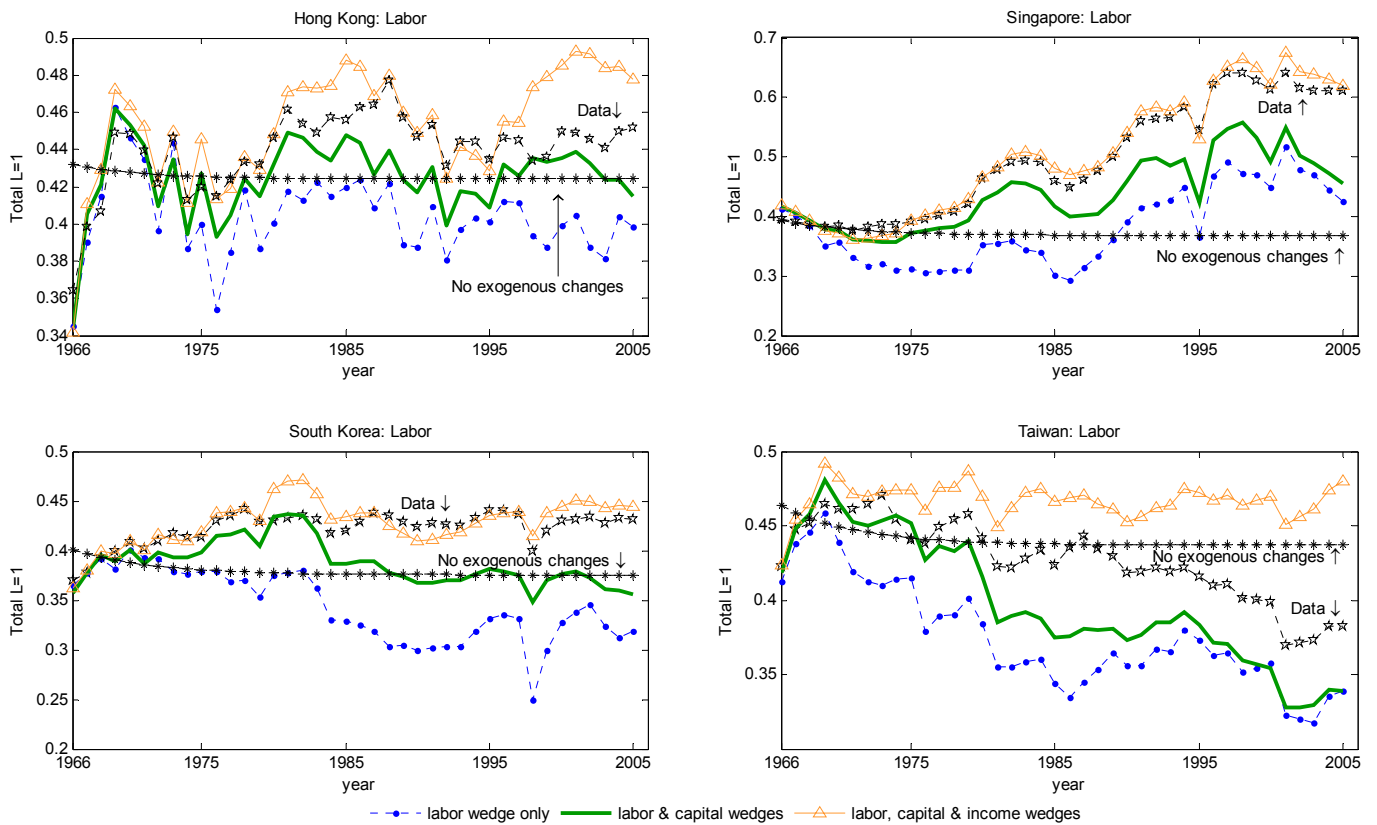


Figure C-10: (Baseline case: L/N) The trajectories from the simulations that sequentially add in wedges (in sequence of the labor wedge, the capital wedge, the income wedge and TFP) versus those from the model with no exogenous changes and data (the model with four wedges).

C.3.3. Figures for capital-to-labor ratio (K/L): Figs. C-11 and C-12

Figure C-11 (which is constructed similarly to Fig. C-3) shows the transition dynamics of K/L from the model with one wedge only. As can be seen, the capital wedge raises the K/L in the earlier stages of development.

Figure C-12 (which is constructed similarly to Fig. 5 in the main text) shows the transition dynamics of K/L when sequentially adding the capital wedge, TFP, the labor wedge, and the income wedge into the model (in the same order as Fig. 5 in the main text). As can be seen, the model with the capital wedge plus TFP captures most of the transition dynamics of Hong Kong, South Korea, and Taiwan. For Singapore, the model with capital wedges alone already captures most of the transition dynamics of K/L . Thus, capital wedges tend to be important in the earlier stages of development, and TFP growth tends to be important in the later stages of development, especially for Hong Kong, South Korea and Taiwan. In particular, the contribution of TFP to K/L has become important since the early 1980s for Hong Kong and Taiwan, and since the early 1990s for South Korea.

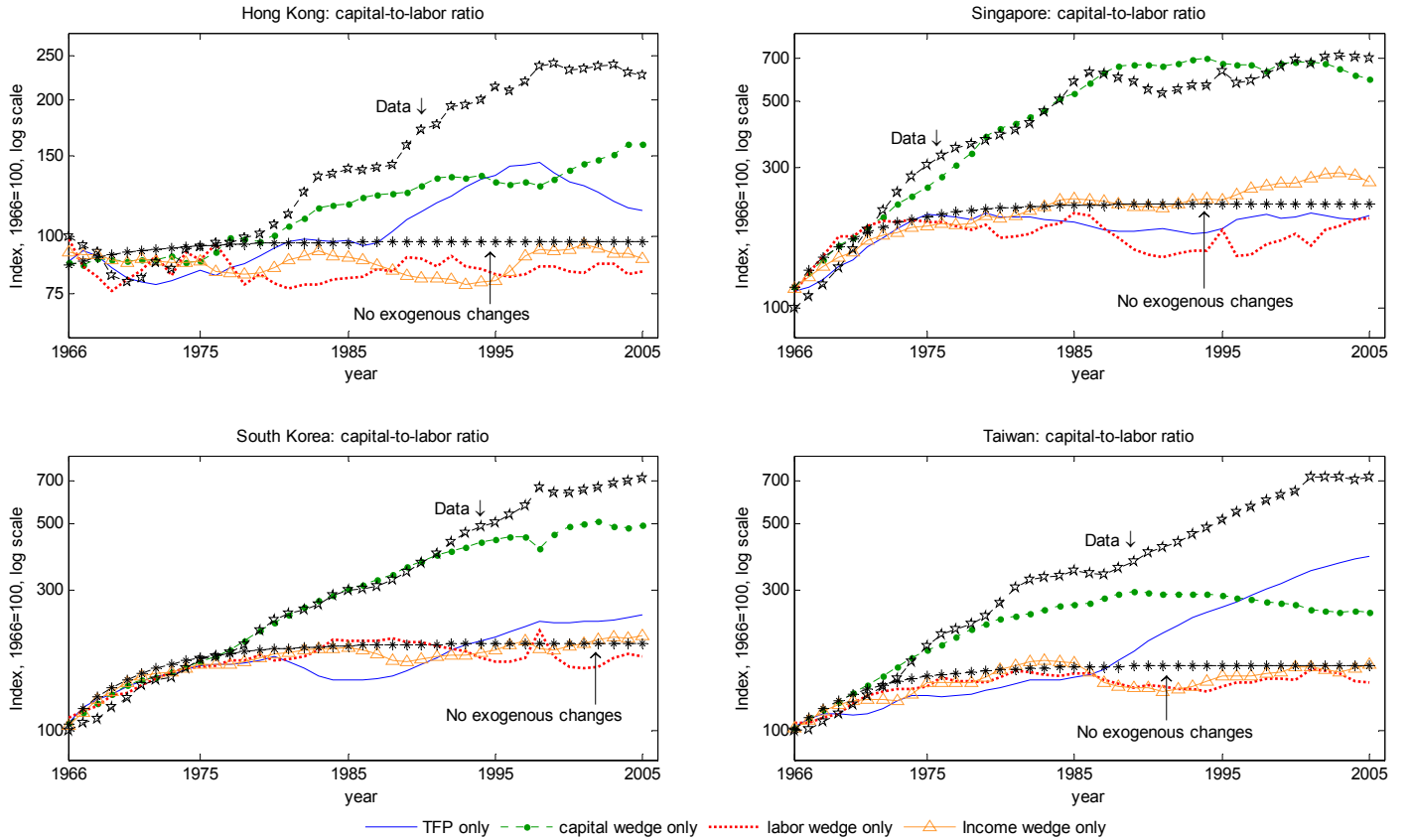


Figure C-11: (Baseline case: K/L , detrended.) The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

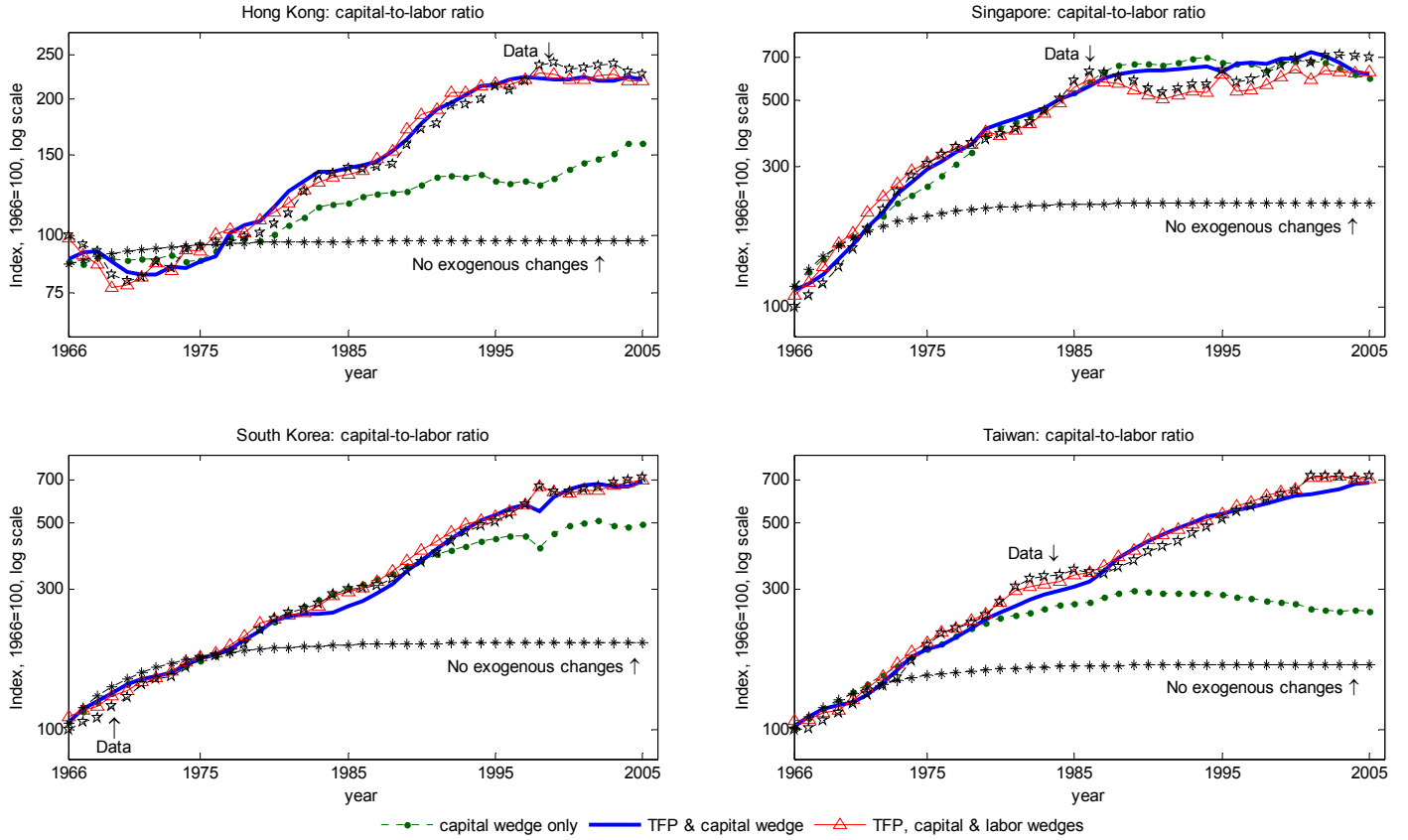


Figure C-12: (Baseline case: K/L , detrended.) The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, TFP, the labor wedge and the income wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

C.3.4. Bar graphs for the contribution of each wedge in two sub-periods: Figs. C-13 to C-15

In this section, I split the sample period into two rather arbitrary sub-periods—cutting the period approximately into two halves (the first half is 1966–1985; the second half is 1985–2005)—and summarize the contribution of each wedge to I/Y , L/N and K/L . These figures (Figs. C-13, C-14, and C-15) are constructed similarly to Fig. 4 in the main text.

I find that much of these variables' growth is explained by the capital wedge in the earlier stages. In the later stages, the capital wedge mainly drives I/Y to fall and the rising income wedge drives L/N to rise. Moreover, the capital wedge and TFP are the two main drivers of the rising K/L for all the countries except Singapore.

Figure C-13 summarizes the results for I/Y . I find that forces generating the effect resembling the capital wedge are the critical forces that contribute to the rising I/Y in 1966–1985 and the falling I/Y in 1985–2005.

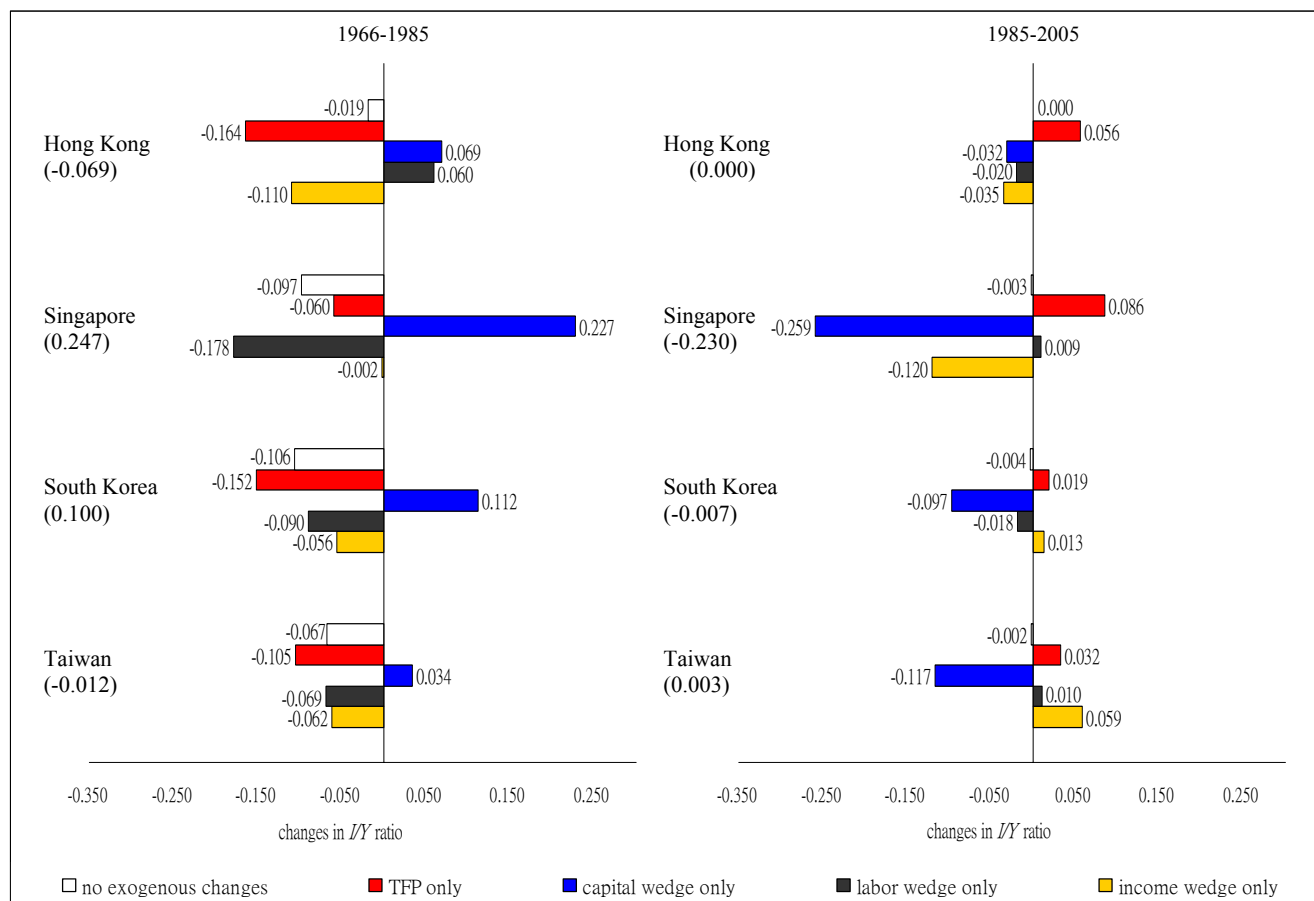


Figure C-13: (Baseline case: I/Y) The changes in I/Y of data and the changes in I/Y generated by the models with no exogenous changes and with one wedge only in two sub-periods.

Figure C-14 summarizes the results for L/N . I also find that the capital wedge dominates the first half and the income wedge dominates the second half. This is especially true for Singapore and South Korea. For Hong Kong, the exception is that in 1966–1985 the labor wedge is the prime driver. For Taiwan, the exception is that in 1966–1985 the income wedge is the prime driver. These are outcomes of the arbitrary demarcation point for the two sub-periods.⁴

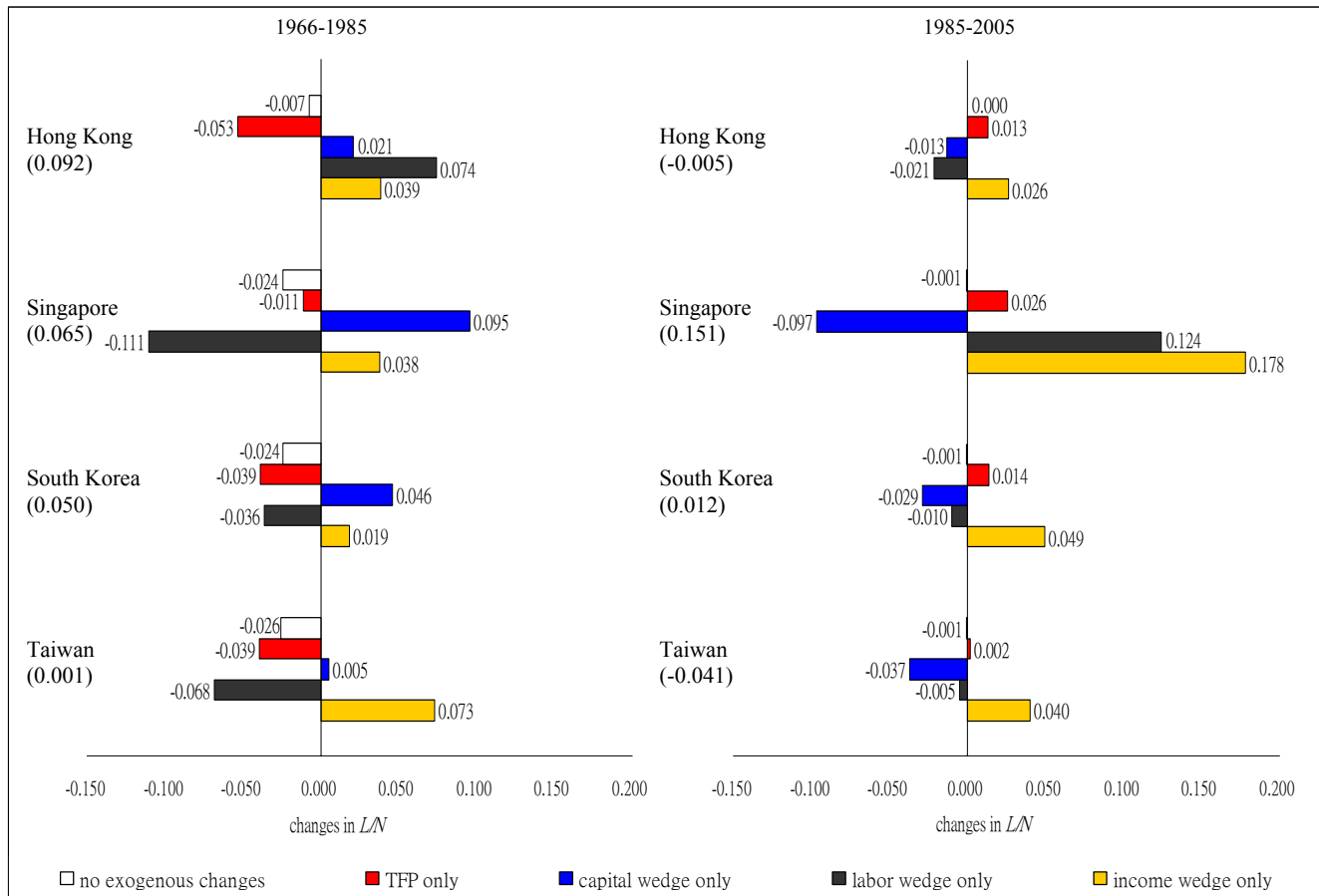


Figure C-14: (Baseline case: L/N) The changes in L/N of data and the changes in L/N generated by the models with no exogenous changes and with one wedge only in two sub-periods.

⁴ For Hong Kong, the labor wedge also positively contributes to the growth in this variable, especially in the late 1960s and between the late 1970s and the early 1980s. For Taiwan, the income wedge began to contribute to growth in L/N in the 1970s. Thus, when choosing 1985 as the demarcation point for the two sub-periods, the contribution of the labor wedge is larger for Hong Kong and that of the income wedge is larger for Taiwan than that of the capital wedge in 1966–1985.

Figure C-15 summarizes the average annual growth rate of K/L . Again, I find the capital wedge dominates the first half and TFP the second. This is especially true for Taiwan. In 1985–2005, the capital wedge is still critical for Hong Kong and South Korea, and the income wedge is important for Singapore. Again, these are the consequence of the arbitrary break in the data.⁵

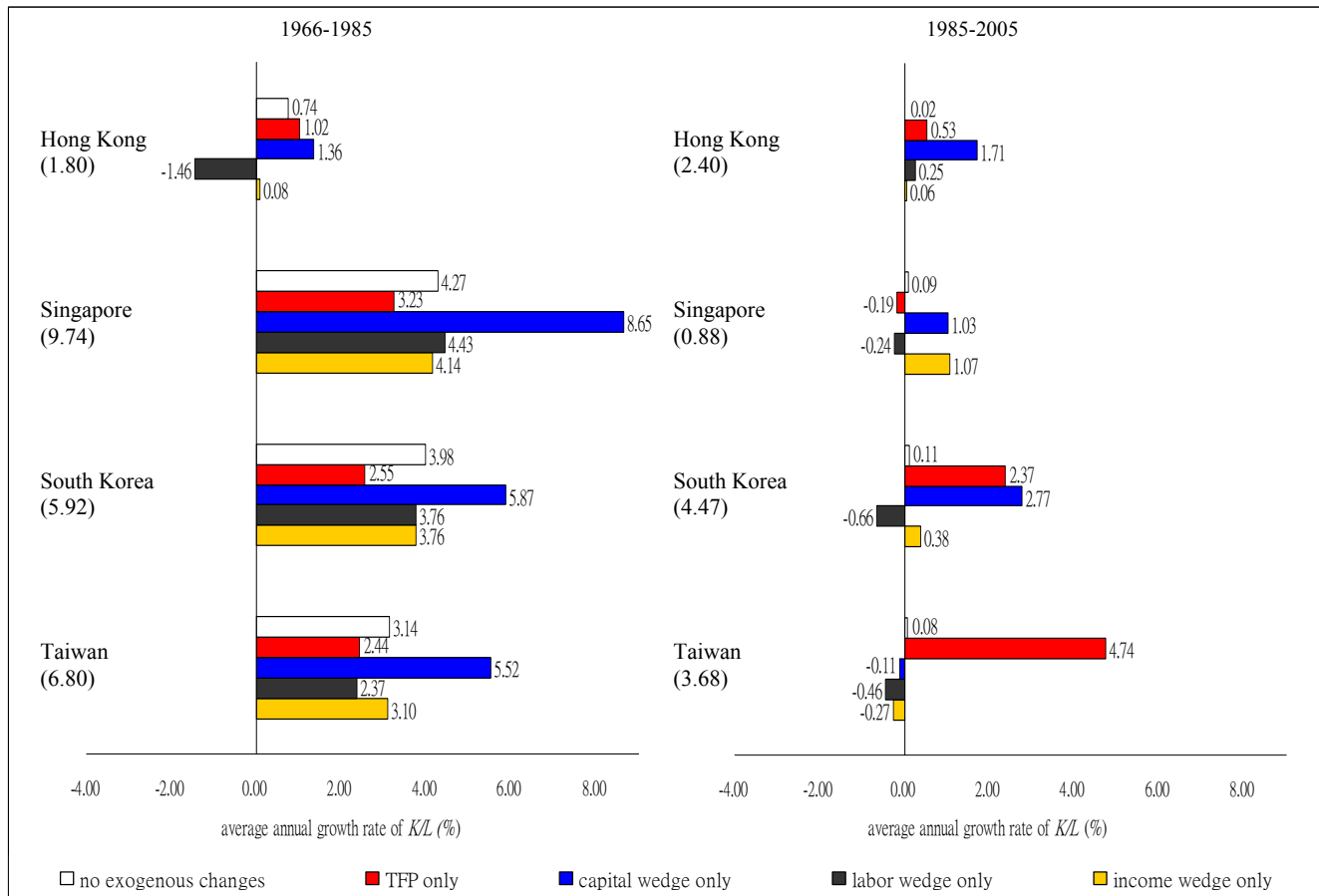


Figure C-15: (Baseline case: K/L) The average annual growth rate of data and those generated by the models with no exogenous changes and with one wedge only in two sub-periods. Note: The number shown below the country name is the average annual growth rate for the detrended (by 2%) path of K/L in the data. The numbers shown next to the bar indicate the growth rate (detrended) generated by the following counterfactual simulations: the model with no exogenous changes, the model with TFP only, the model with a capital wedge only, the model with a labor wedge only, and the model with an income wedge only. (Unit: %).

⁵ For Hong Kong, since TFP began to dominate in the early 1980s but TFP fell between 1995 and 1999, setting the demarcation point at 1985 leads to a larger contribution of the capital wedge than TFP. For Singapore, since the income wedge is the critical wedge driving K/L to fall and rise in 1985–2005, the income wedge dominates the other wedges in the second half. For South Korea, since TFP began to dominate in the early 1990s, setting 1985 as the demarcation point makes the capital wedge dominate the change of K/L in the second half.

Technical Appendix D: Sensitivity Analysis

In addition to the baseline case, I also perform a couple of sensitivity analyses. First, I examine how sensitive the results are when allowing different sequences of adding in wedges (see section D.1). Second, I examine how the result changes when focusing only on the long-term trend (see section D.2). Third, I also examine how sensitive the results are when there are changes in the settings of the model (see sections D.3-D.5).

In general, different focus/settings result in different wedge values, but the trend and pattern remain similar to those of the baseline case. Moreover, qualitatively, the models with different focus/settings also predict results similar to those of the baseline case: The mechanism generating effects that manifest as rising capital wedges is critical in driving the growth of output per working-age person (Y/N) in the earlier stages of development. Then, TFP growth becomes important in sustaining the growth in the later stages of development (despite the fact that the value differs).

D.1. Different sequences for adding in wedges

Now I examine how different sequences of adding wedges affect the contributions of each wedge to output growth.

When including an additional wedge to generate a path, I assume that all the correlations of that wedge to other wedges are attributed to the particular wedge that is added. Under this assumption, the additional growth rate generated by this particular wedge is the marginal contribution of the wedge to growth. However, in reality, each wedge is not orthogonal to the remaining wedges, and each wedge can show up in the model in eight different sequences. Thus, the sequence of adding in a wedge dictates the size of the marginal contribution of that wedge to growth.

Thus, I explore whether my main conclusion is robust when the wedges are allowed to be added to the model in different sequences. I do that first by computing the average annual growth rate of Y/N —which is detrended by 2%, again, for two sub-periods: 1966–1985 and 1985–2005—generated by models with different combinations of wedges (There are 16 different combinations). Then, I summarize the range of the marginal contribution of each wedge to the average annual growth of Y/N and report it in Table D-1. Each cell of the table summarizes the range of the marginal contribution of each wedge from eight pairs of simulations. If the average annual growth rate implied by the model with that wedge is higher (lower) than that without, the marginal contribution is positive (negative).

The range of the contribution of each wedge to the growth of the detrended Y/N suggests that during the earlier stages, the capital wedge is important in accounting for the growth of the detrended Y/N (except for Taiwan, the range of the contribution of capital wedges overlaps with that of TFP and income wedges). Moreover, during the later stages, the additional growth rate created by changes in TFP is greater than that for all other wedges. (Except for Singapore, the range of the contribution of TFP overlaps with that of labor wedges and income wedges.) Therefore, the conclusion is slightly different from the baseline case, but the general patterns remain similar to those patterns derived from the baseline case.

Table D-1: The range of contribution of different wedges to the growth of Y/N , detrended by 2%

	<i>contribution of TFP</i>	<i>contribution of capital wedges</i>	<i>contribution of labor wedges</i>	<i>contribution of income wedges</i>
<u>1966-1985</u>				
Hong Kong	0.01% ~ 0.24%	0.81% ~ 0.98%	0.71% ~ 0.77%	0.46% ~ 0.72%
Singapore	0.16% ~ 0.31%	2.93% ~ 3.24%	-1.02% ~ -0.92%	0.87% ~ 1.17%
South Korea	-0.53% ~ -0.44%	1.64% ~ 1.82%	-0.10% ~ 0.00%	0.54% ~ 0.80%
Taiwan	0.97% ~ 1.64%	1.09% ~ 1.63%	-0.60% ~ -0.26%	0.74% ~ 1.75%
<u>1985-2005</u>				
Hong Kong	0.82% ~ 1.05%	0.31% ~ 0.48%	-0.19% ~ -0.14%	0.09% ~ 0.34%
Singapore	1.04% ~ 1.73%	-1.47% ~ -0.65%	0.89% ~ 1.67%	0.57% ~ 2.13%
South Korea	2.02% ~ 2.64%	0.34% ~ 0.74%	-0.31% ~ -0.15%	0.13% ~ 0.92%
Taiwan	3.06% ~ 4.01%	-0.50% ~ -0.27%	-0.24% ~ 0.00%	-0.41% ~ 0.62%

D.2. Different data inputs: with data filtered out business cycles

Now I examine how sensitive the results are when focusing only on the long-term trend by using the data input with the cyclical components of the time series filtered out.

I filter the cyclical components out of the data using the Hodrick-Prescott filter with a smoothing parameter that equals 6.25, following Ravn and Uhlig (2002). Then I use the smoothed data to calibrate parameters, compute the wedges, and feed them into the model to examine the contribution of each wedge to the growth of Y/N (which repeats the simulations conducted for the baseline case).⁶

I take the first BCA step of measuring the wedges. Figure D.2-1 displays the computed wedges. In comparison with Fig. 2 in the main text, I find that the wedges do not change much when focusing only on the long-term trend.

Then I feed the measured wedges into the model to identify the prime driver to output growth—the second BCA step. Figures D.2-2, D.2-3, and D.2-4 illustrate the role of TFP and other wedges in the growth in Y/N . In comparison with Figs. 3 and 5 in the main text and Fig. C-3 in Technical Appendix C.2.1, I find that filtering out business cycles for data implies the same conclusion as that of the baseline case. The only difference between this case and the baseline case is that the trend has become clearer.

⁶ Since all the data inputted are filtered out the cyclical components, the parameters that are computed based on data are slightly different. The terminal population growth rate is 0.9% for Hong Kong, 1.61% for Singapore, 0.42% for South Korea, and 0.85% for Taiwan. The 40-year average annual growth rate of the working-age population is 2.34% for Hong Kong, 2.26% for Singapore, 2.03% for South Korea, and 2.24% for Taiwan. The depreciation rate is 7.68% for Hong Kong, 5.90% for Singapore, 4.97% for South Korea, and 6.17% for Taiwan.

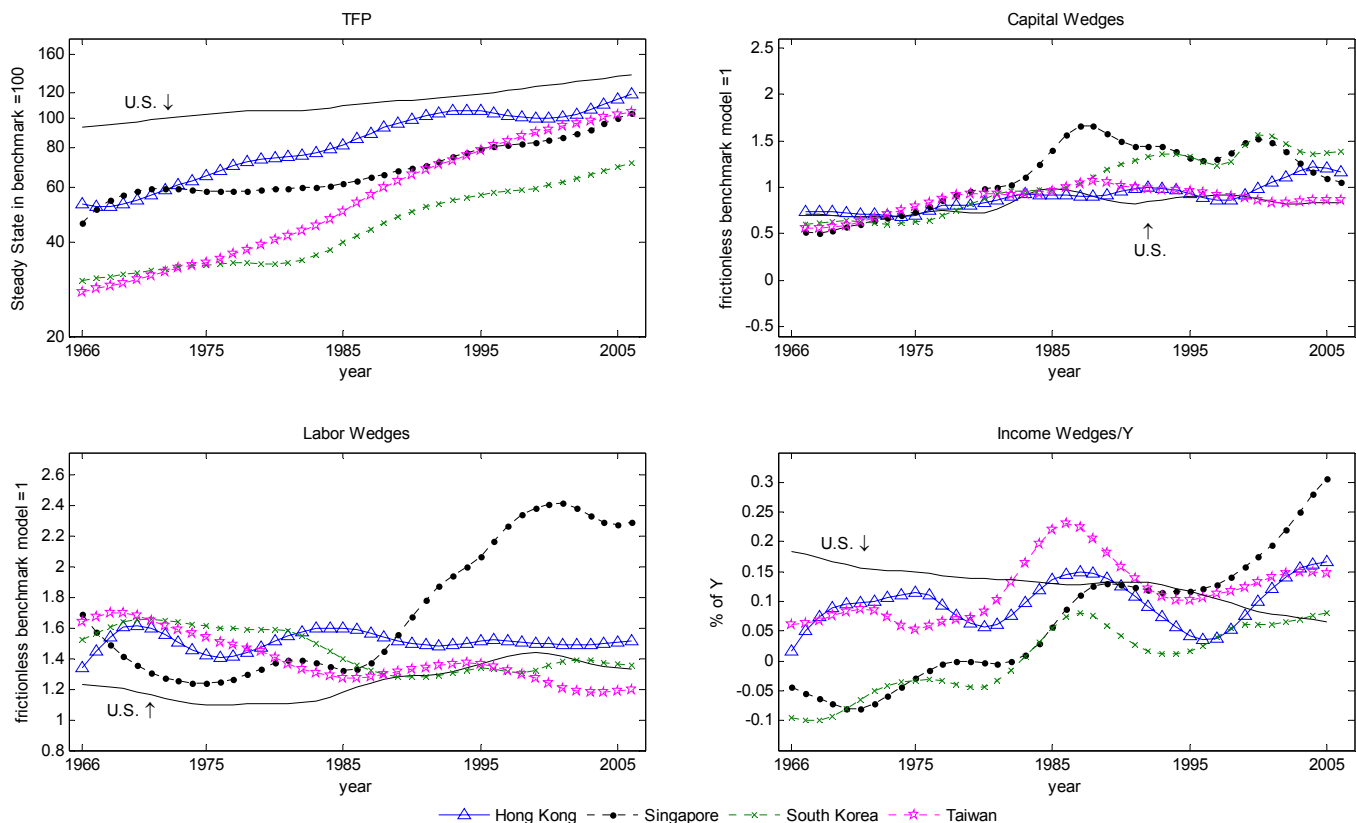


Figure D.2-1: Wedges for the scenario using the time series filtered-out business cycle (with terminal condition $\gamma = 0$, and all the wedges were filtered using the Hodrick-Prescott filter with a smoothing parameter = 6.25).

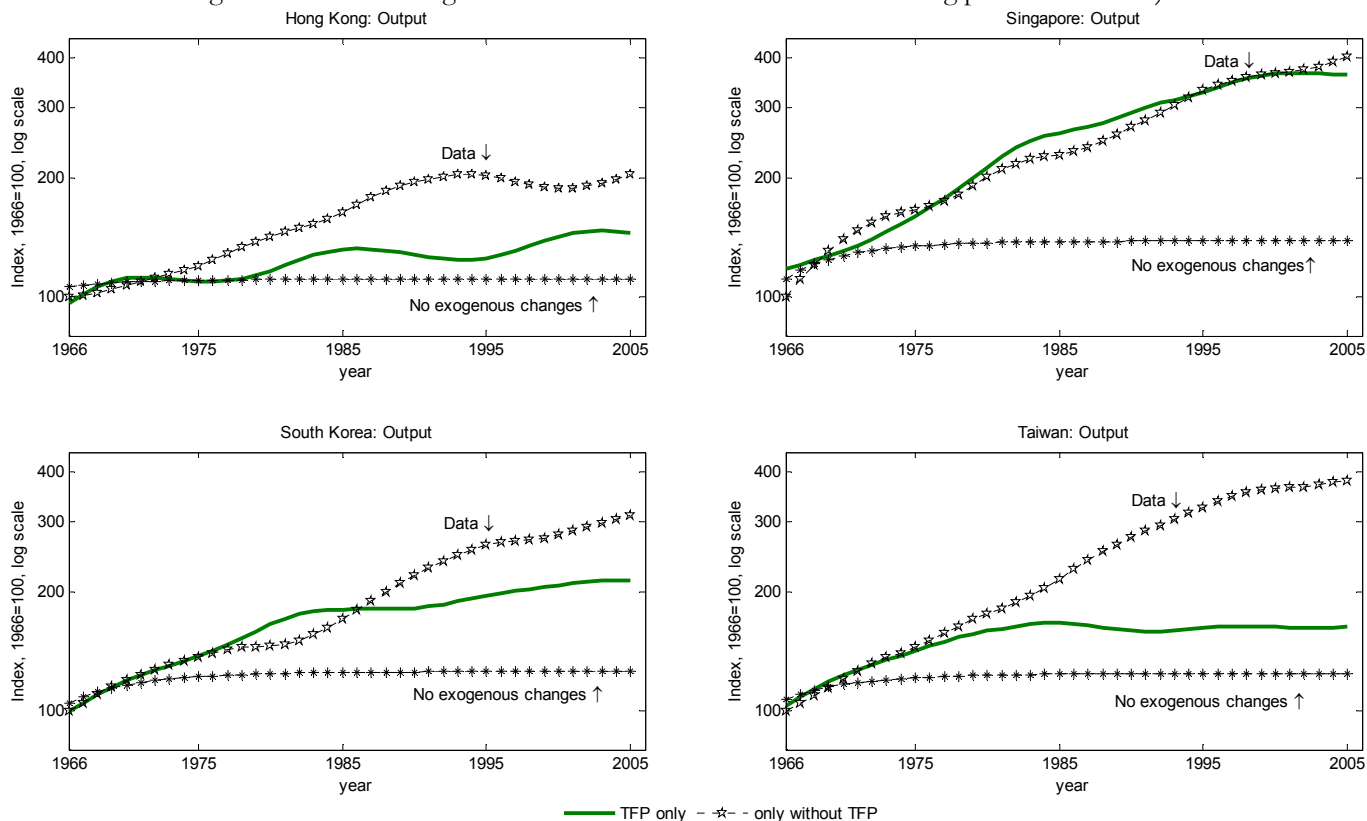


Figure D.2-2 (Using the time series filtered-out business cycles: Y/N , detrended.): The trajectories from the models with all wedges but TFP (i.e., without TFP) versus those from the model with no exogenous changes and data (the model with four wedges).

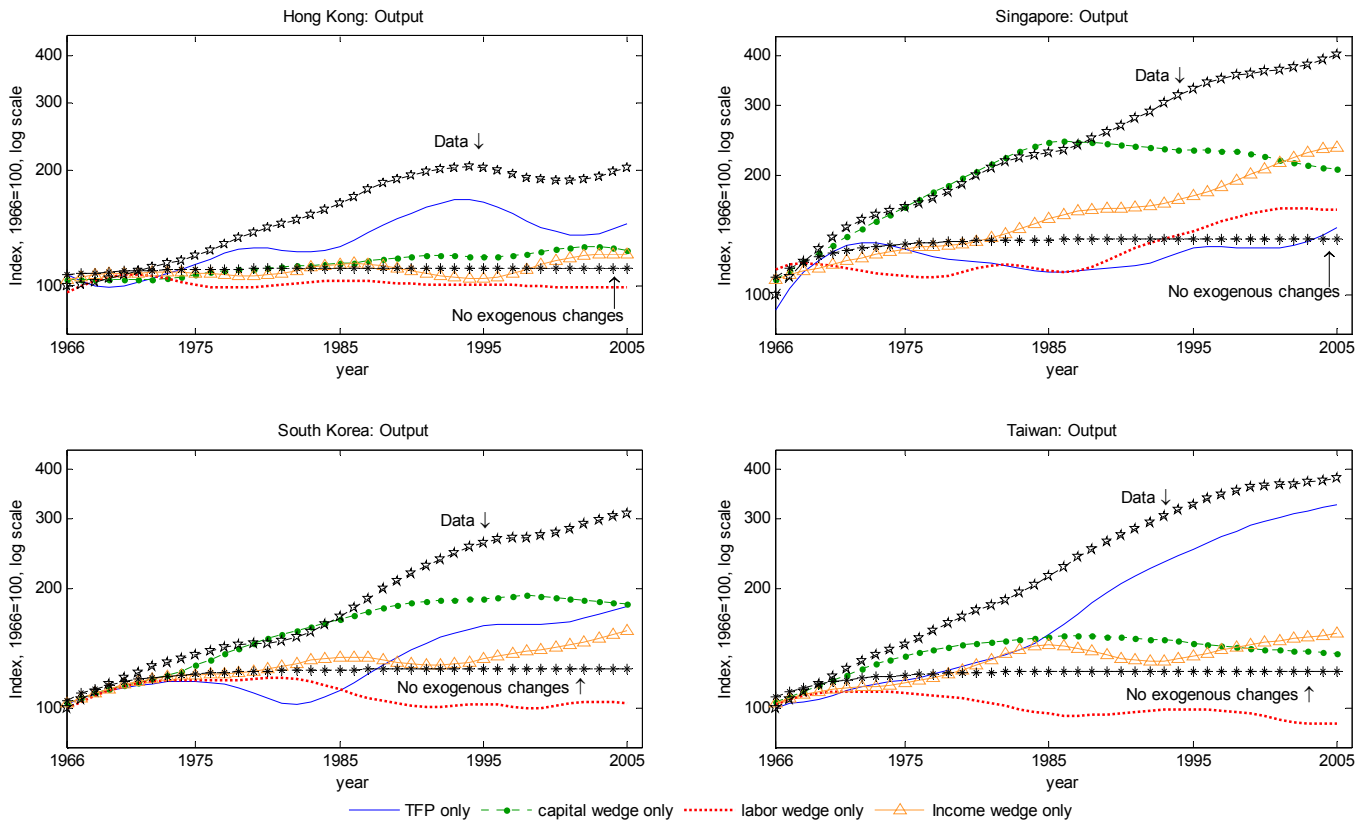


Figure D.2-3: (Using the time series filtered-out business cycles: Y/N , detrended.): The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

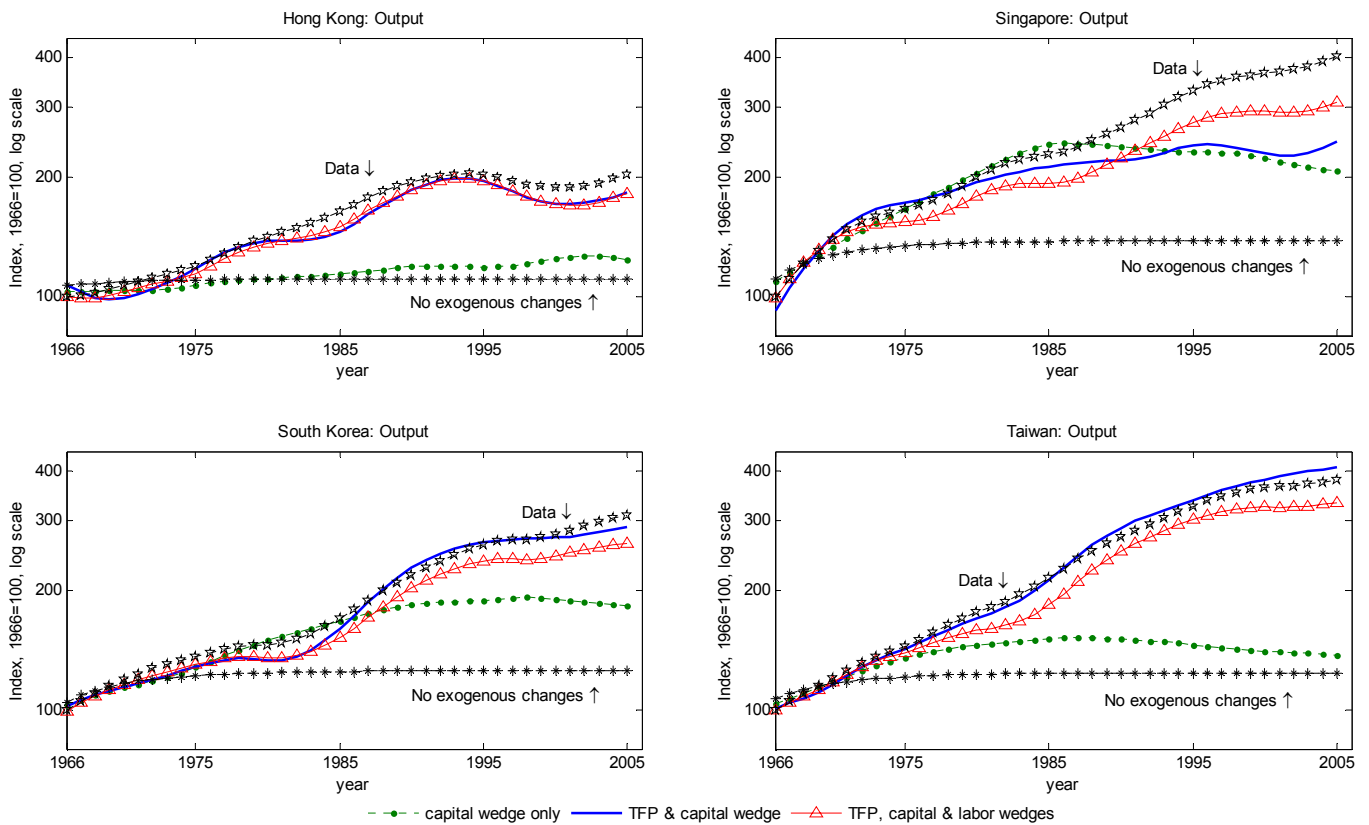


Figure D.2-4: (Using the time series filtered-out business cycles: Y/N , detrended.): The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, TFP, the labor wedge and the income wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

D.3. Different terminal conditions

Now I examine how sensitive the results are when making different assumptions for the terminal conditions. The terminal conditions are the assumptions for the population growth rate and the technological growth rate after 2006. The baseline case assumes that the population growth rate equals the growth rate of the working-age population in 2006 and the technological growth rate equals 2% from 2006 onward. Alternatively, it is also reasonable to assume that the growth rate after 2006 equals the average of the realized growth rates between 2000 and 2006, which is assumed to be the value of the steady state.

To demonstrate that the results are not sensitive to different assumptions, I provide a simulation with alternative assumptions regarding terminal conditions. In this exercise, I assume that all wedges are constant after 2006 (at their 2006 value for $t = 2006$), except for productivity, which takes on the value in 2006, and grows at a technological growth rate γ , which is the average TFP growth rate of 2000-2006 (i.e., 3.18% for Hong Kong, 3.22% for Singapore, 2.93% for South Korea and 2.18% for Taiwan). In addition, the model allows the working-age population to grow at the average of 2000-2006 (i.e., 0.95% for Hong Kong, 1.54% for Singapore, 0.54% for South Korea and 0.99% for Taiwan) from 2006 onward.

By taking the first BCA step, I measure the wedges and show them in Figure D.3-1. In comparison with Fig. 2 in the main text, I find that the patterns of the wedges are similar to those of the baseline case.

Then, I take the second BCA step, feeding the wedges into the model, to identify the prime driver of output growth. Figures D.3-2, D.3-3, and D.3-4 illustrate the role of TFP and other wedges in the growth of Y/N . In comparison with Figs. 3 and 5 in the main text and Fig. C-3 in Technical Appendix C.2.1, I find that the main conclusion remains the same as that of the baseline case: factor accumulation resulting from rising capital wedges is the primary contributor of rapid output growth at first, but eventually is replaced by TFP growth. In particular, just as I found in the main text, if there were no TFP improvement, growth would have slowed down for Hong Kong between the mid-1980s and the mid-1990s, for Singapore in the 2000s, for South Korea since the early 1980s, and for Taiwan since the late 1970s.

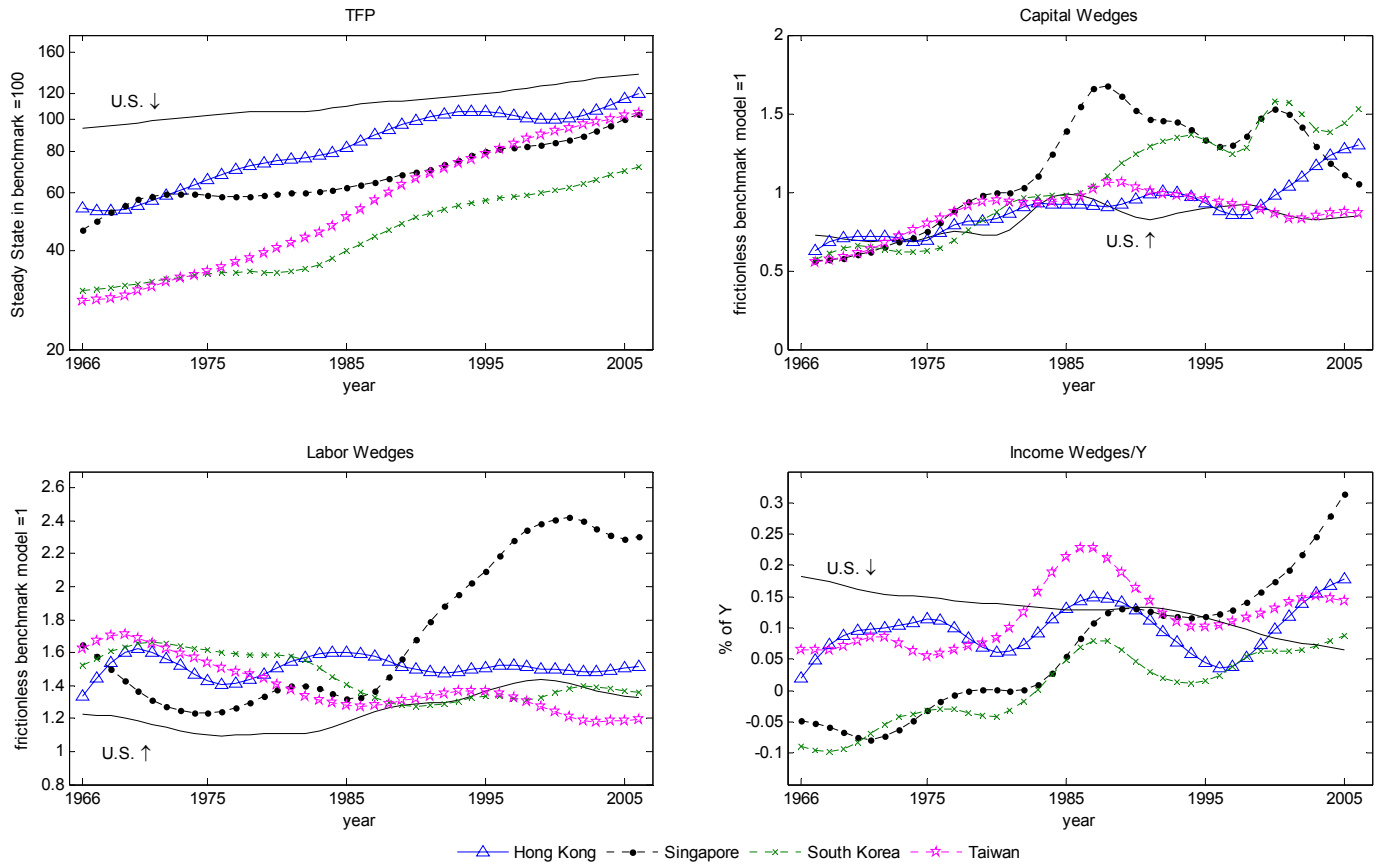


Figure D.3-1: Wedges for the model with country-specific v (average of 2000-2006) and terminal condition $\gamma = 0$.
 (All the wedges were filtered using the Hodrick-Prescott filter with a smoothing parameter = 6.25.)

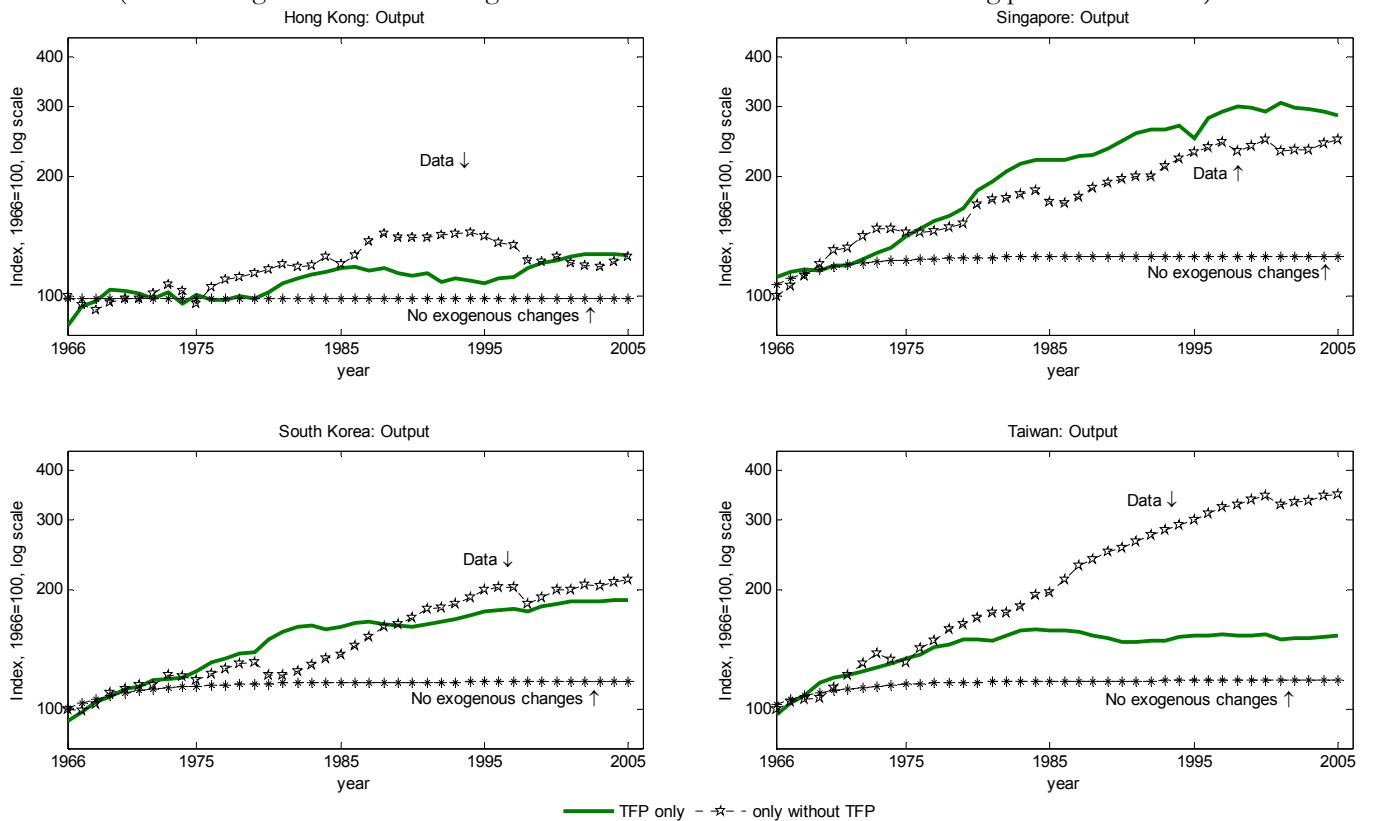


Figure D.3-2: (Using country-specific γ and v : Y/N , detrended.): The trajectories from the models with all wedges but TFP (i.e., without TFP) versus those from the model with no exogenous changes and data (the model with four wedges).

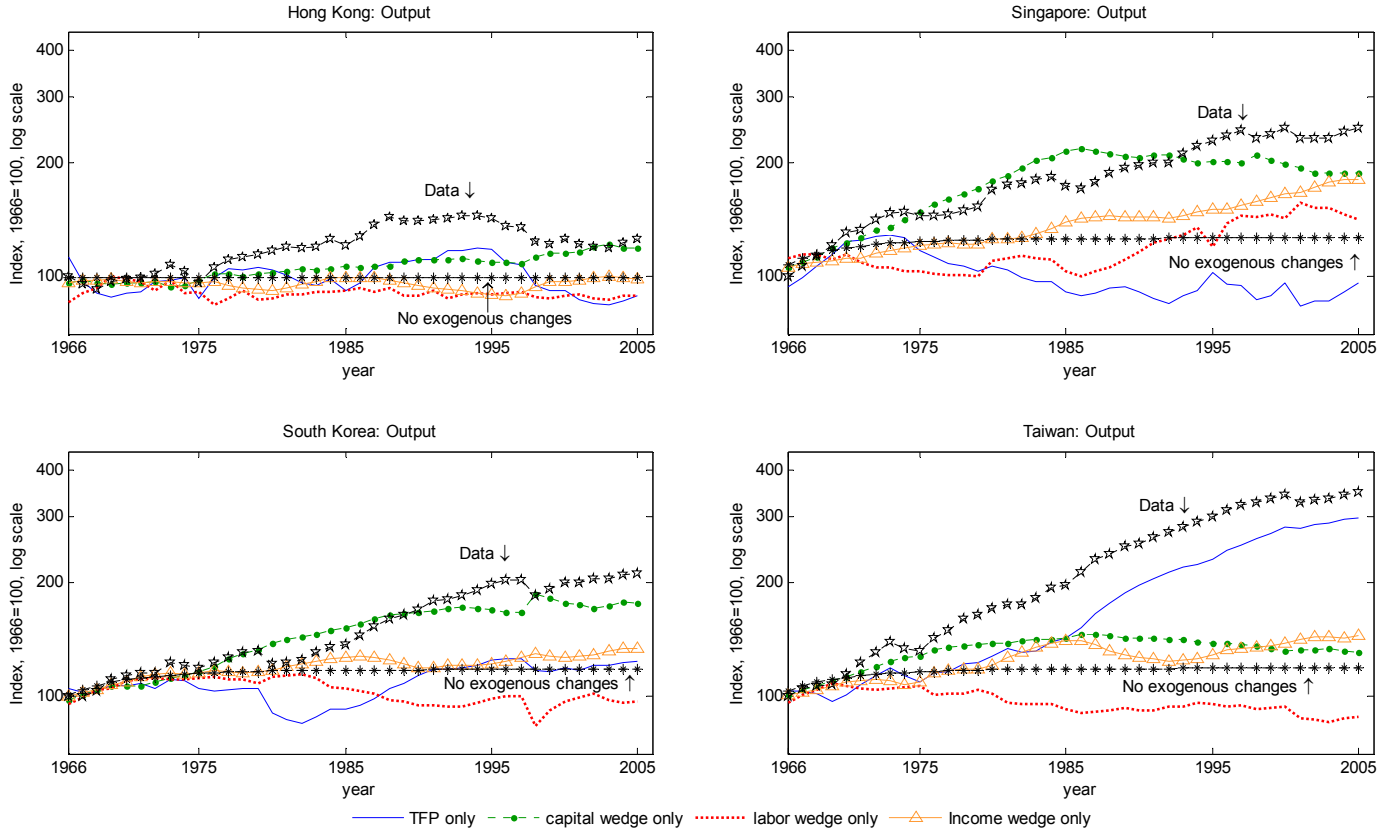


Figure D.3-3: (Using country-specific γ and ν : Y/N , detrended.): The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

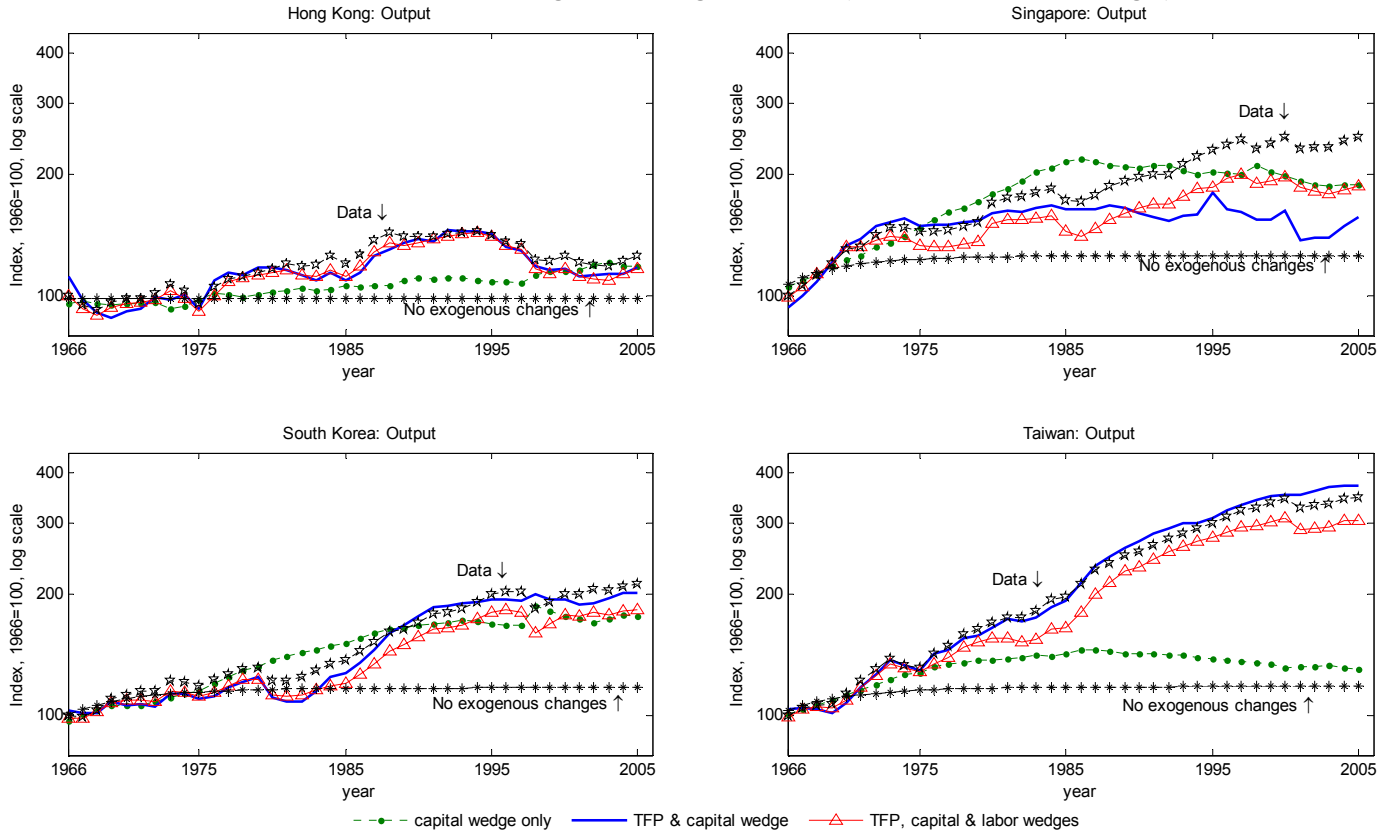


Figure D.3-4: (Using country-specific γ and ν : Y/N , detrended.): The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, TFP, the labor wedge and the income wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

D.4. Different parameters

D.4.1. Country-specific capital share

Now I examine how sensitive the results are when allowing each country to have its own value for capital share. The capital share is a critical component determining the percentage contributions of capital and the labor input on growth. Therefore, I examine how different values of capital shares affect the results in this paper. Alternatives for the capital share are those directly estimated using data. Therefore, I applied those reported in Young (1995) and Hsieh (2002) and examine how the country-specific capital share would have changed the result. The capital shares applied are as follows: 0.37 for Hong Kong, 0.49 for Singapore, 0.30 for South Korea and 0.26 for Taiwan.

Figure D.4.1-1 displays the computed wedges (obtained by taking the first BCA step). In comparison with Fig. 2 in the main text, the patterns of the wedges are similar to the baseline case for all the wedges except TFP. Nevertheless, the trend is that TFP growth is still faster than that of the U.S., especially for Hong Kong, South Korea and Taiwan.

Figures D.4.1-2, D.4.1-3, and D.4.1-4 illustrate the role of TFP and other wedges in the growth of Y/N (obtained by taking the second BCA step). In comparison with the conclusion drawn from Figs. 3 and 5 in the main text and Fig. C-3 in Technical Appendix C.2.1, the conclusion remains the same as that of the baseline case. In general, TFP growth is important in the later stages of development, whereas the role of factor accumulation, especially the growth arising from the rising capital wedge, remains non-trivial in the earlier stages of development. Since the country-specific capital shares chosen are much higher than $1/3$ for Hong Kong and Singapore, the role of capital accumulation (and thus the contribution of factor accumulation to growth) is amplified. In spite of that, however, if there had been no TFP growth, the output growth in Hong Kong between the mid-1980s and the mid-1990s and in Singapore in the 2000s would have slowed down. On the contrary, the country-specific capital shares chosen are less than $1/3$ for South Korea and Taiwan, and thus the contribution of TFP improvement to growth is enlarged. Nevertheless, factor accumulation remains important in capturing the growth dynamics in the very early stages of development for these two NICs. (This is because the model ‘without TFP’ still replicates the growth trend of Y/N in South Korea and Taiwan in the earlier stages.)

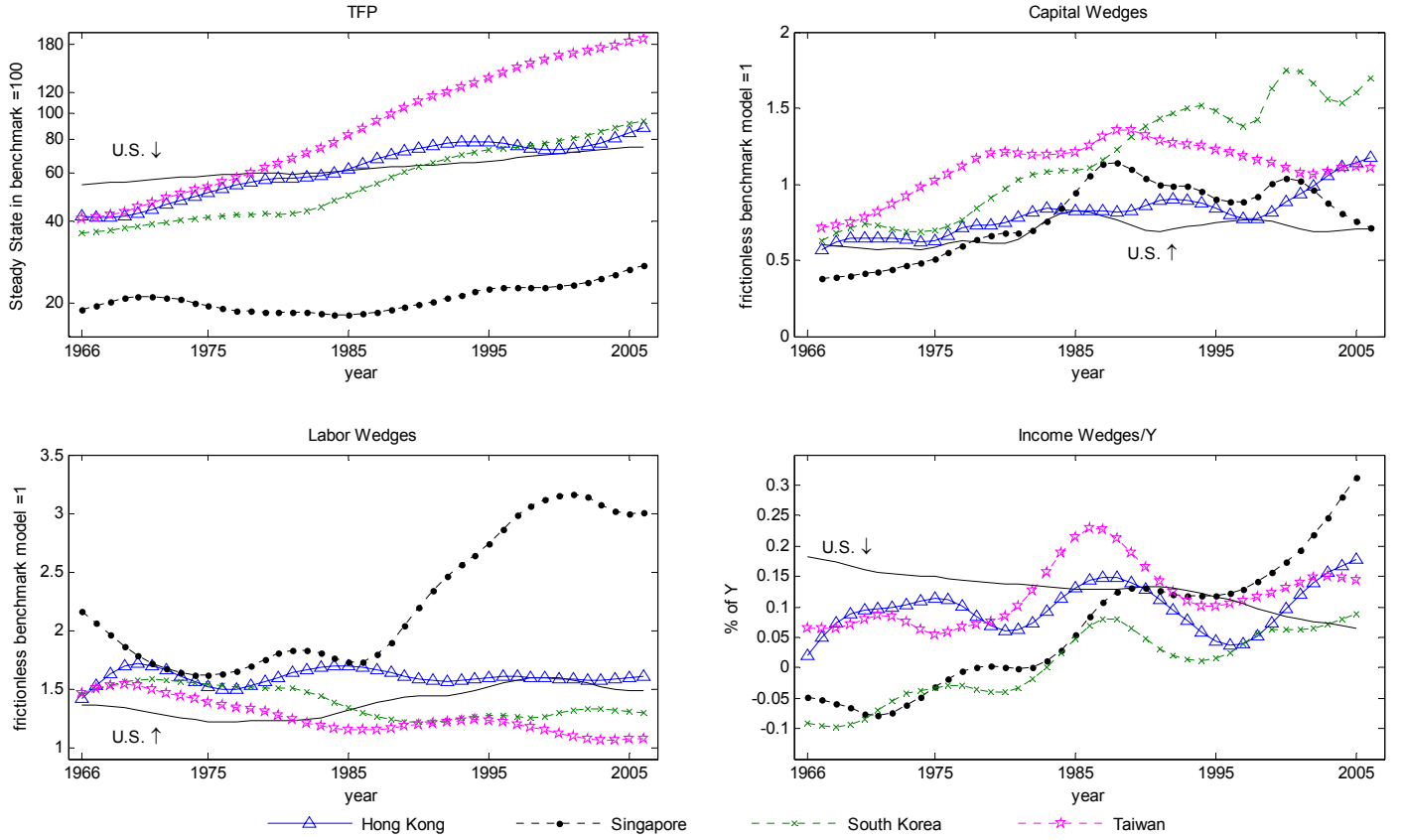


Figure D.4.1-1: Wedges for the model using country-specific θ , with terminal condition $\gamma = 0$.
(All the wedges were filtered using the Hodrick-Prescott filter with a smoothing parameter = 6.25.)

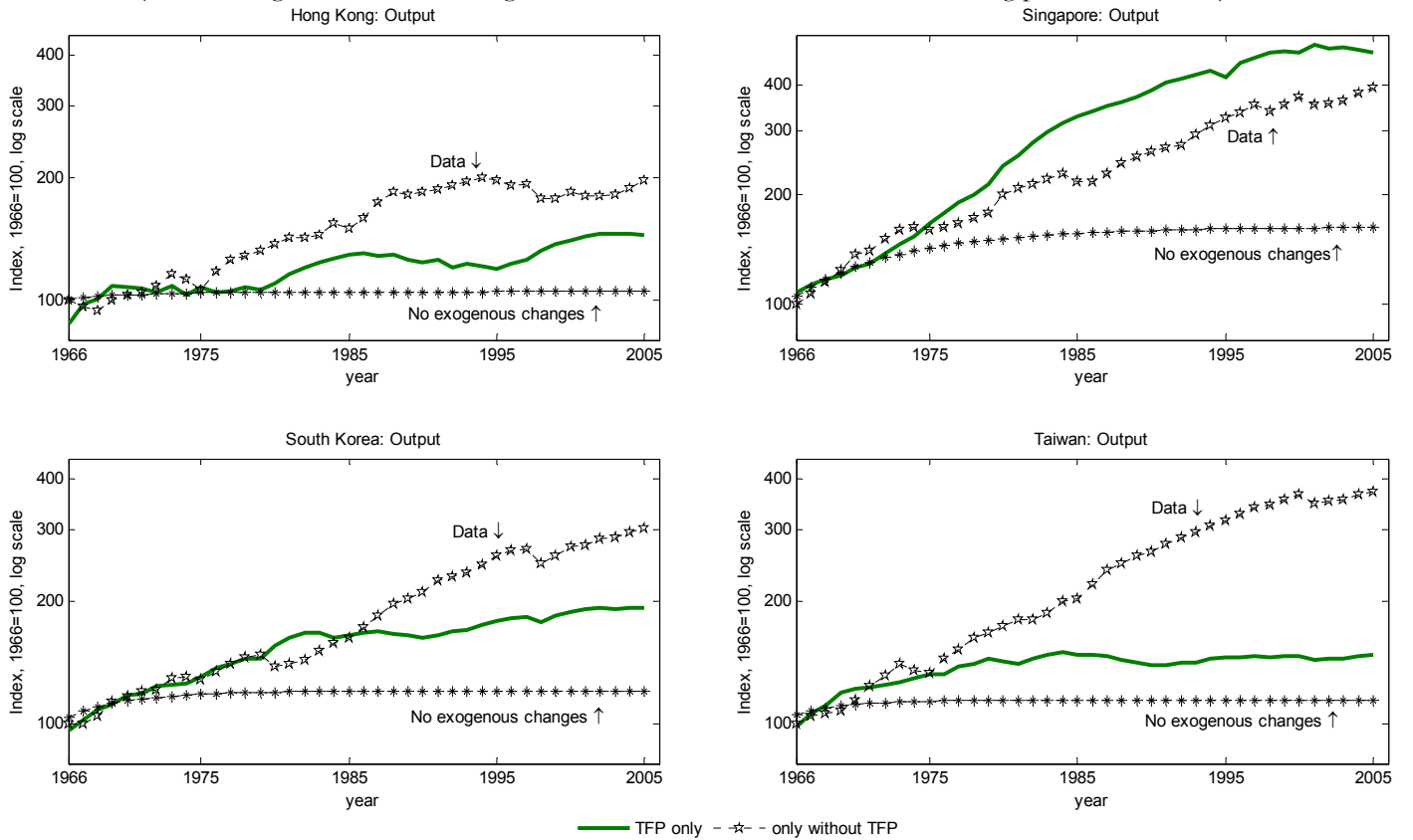


Figure D.4.1-2: (Using country-specific θ : Y/N , detrended.): The trajectories from the models with all wedges but TFP (i.e., without TFP) versus those from the model with no exogenous changes and data (the model with four wedges).

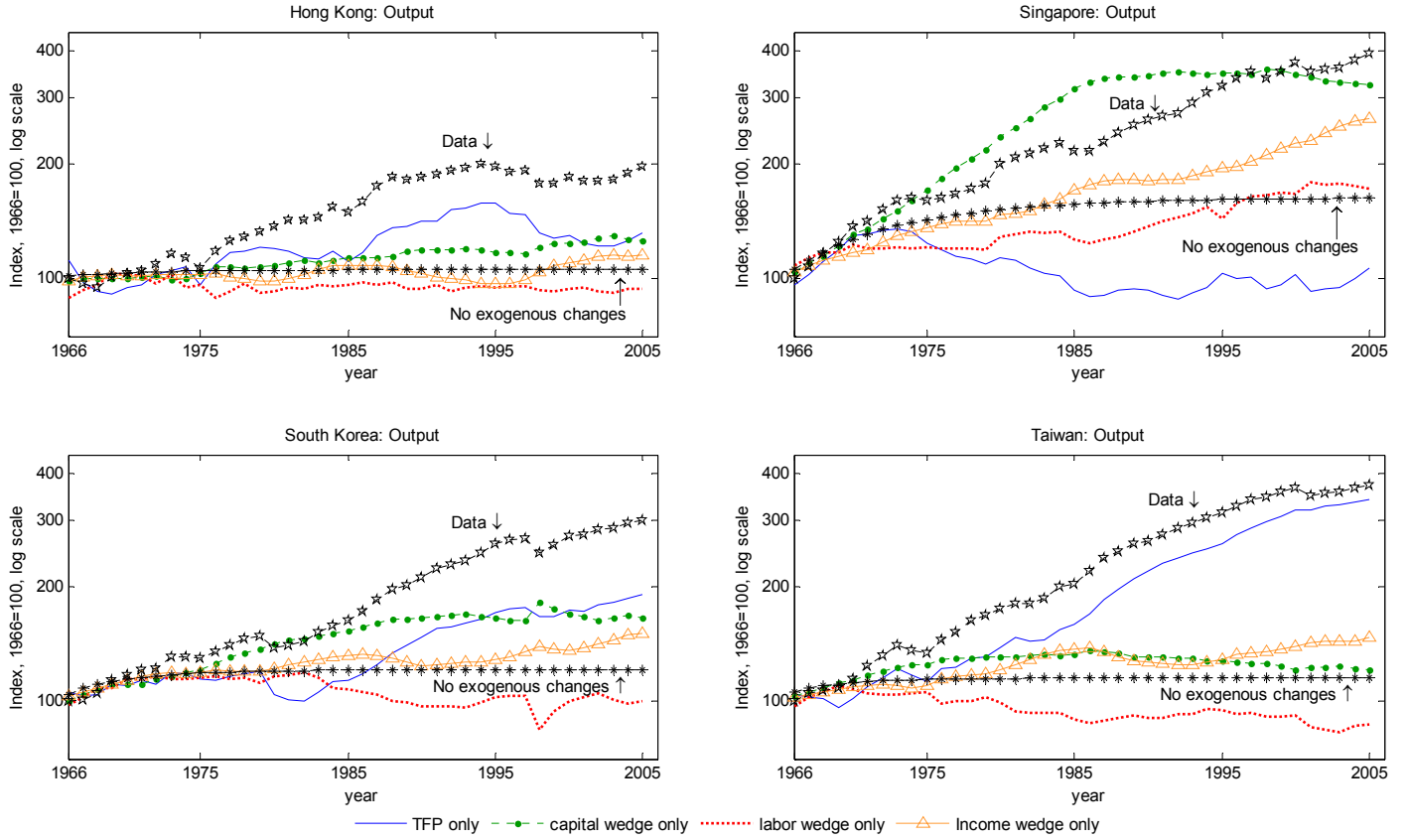


Figure D.4.1-3: (Using country-specific $\theta: Y/N$, detrended.): The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

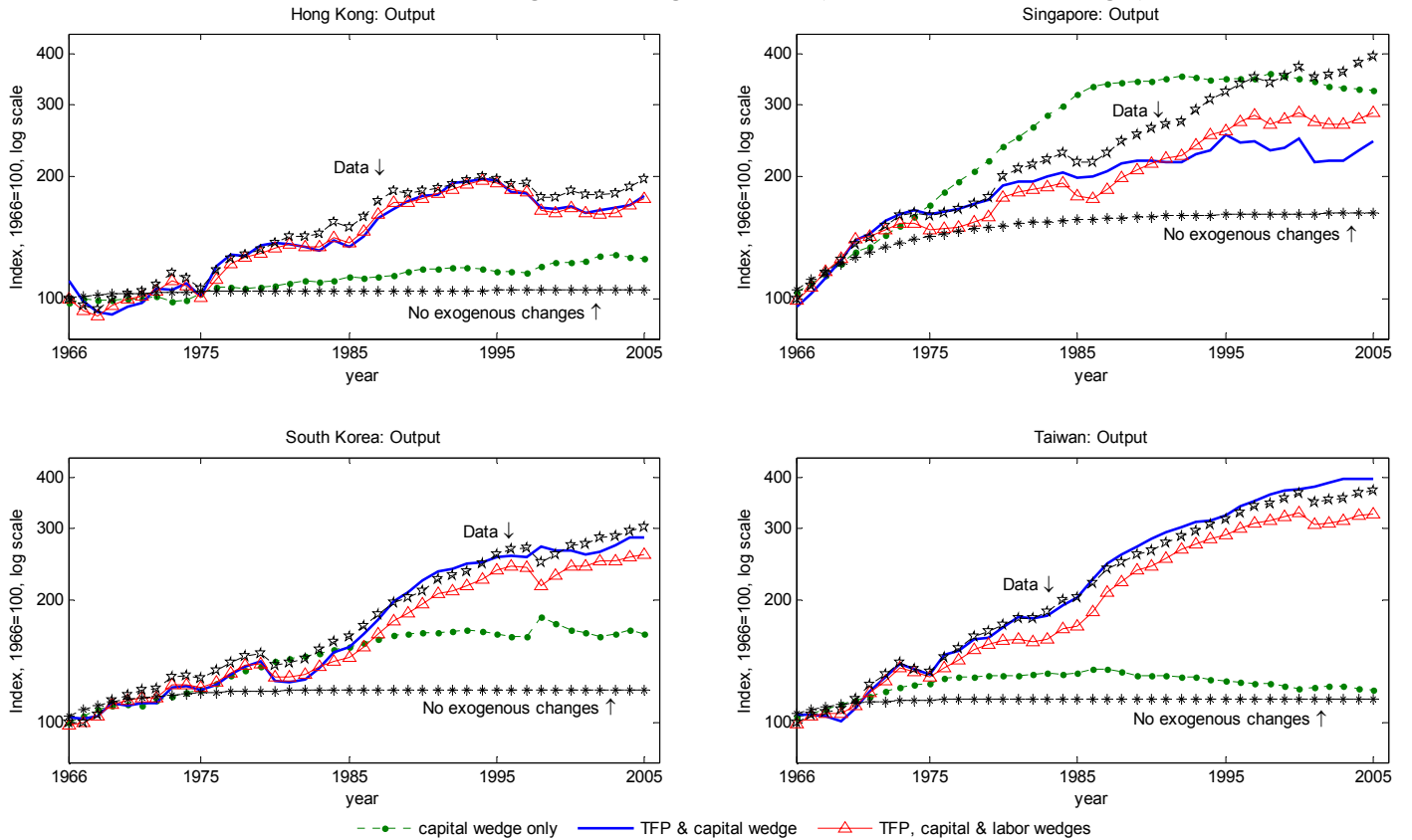


Figure D.4.1-4: (Using country-specific $\theta: Y/N$, detrended.): The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, TFP, the labor wedge and the income wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

D.4.2. Country-specific parameters

Despite all the reasons leading us to choose common parameters (except δ and ν) for this study,⁷ it remains interesting to perform an exercise that allows all the countries to have their own parameters. If the results turn out to be similar to the case with common parameters, it becomes less of a concern when making the compromise for setting common preference parameters across all the NICs.

Under this set of sensitivity analysis, I allow the population growth rate, technological growth rate, depreciation rate and capital share to reflect country-specific characteristics and map them directly from the data. The capital share (θ) is from Hsieh (2002) and Young (1995). In addition, I calibrate all other parameters.

To pin down x_0 , I assume the productivity, z (TFP), equals 100 in the initial year. Therefore,

$$z_{1966} = \frac{\hat{y}_{1966}}{\hat{k}_{1966}^{\theta} (x_0 l_{1966})^{1-\theta}} \equiv 100.$$

In addition, I assume that the TFP from 2006 takes the value of 2006 and continues to grow at the geometric average of 2000-2006 (which is different from those applied in Section D.3. due to different assumptions for capital shares).

To pin down ϕ , I assume that the labor wedge is one in 2006 and so forth; thus,

$$\phi = (1 - l_{2006}) \frac{(1 - \theta) \hat{y}_{2006} / l_{2006}}{\hat{c}_{2006}}$$

To pin down β , I assume that the capital wedge is one in 2007 ($t = 2006$) and so forth; thus,

$$\beta = \frac{(1 + \gamma)}{(1 + \theta \frac{\hat{y}_{2007}}{\hat{k}_{2007}} - \delta)}.$$

Table D.4.2-1 shows the results of the calibration. Based on these calibrated parameters, I conduct the same simulations as those for the baseline case. In brief, the main conclusion remains.

Table D.4.2-1: Country-specific parameters from calibration versus those in the baseline case

	<i>Hong Kong</i>	<i>Singapore</i>	<i>South Korea</i>	<i>Taiwan</i>	Baseline
Growth rate of working-age population (ν)	1.12%	2.09%	0.54%	0.96%	country specific ν
TFP growth rate (γ)	3.14%	2.95%	3.07%	2.49%	2%
Depreciation rate (δ)	7.60%	5.87%	4.93%	6.10%	country specific δ
Capital share (θ)	0.37	0.49	0.30	0.26	1/3
Discount factor (β)	0.94	0.91	0.99	0.96	0.95
Leisure preference parameter (ϕ)	1.25	0.62	1.54	1.86	2
Scalar (x_0)	16.61	2.18	14.44	18.42	60

⁷ For example, to pin down the preference parameters, i.e., β and ϕ , I need to assume the year that the labor wedge and the capital wedge is one, which is subject to judgment.

Figure D.4.2-1 displays the computed wedges. In comparison with Fig. 2 in the main text, the patterns of the wedges are similar to those of the baseline case, but the levels are different. Therefore, another reason is provided for why, when discussing wedges, it makes more sense to interpret trends rather than levels since levels are very sensitive to choices of parameters.⁸

When I take the second BCA step of feeding these wedges back into the model, as shown in Figs D.4.2-2, D.4.2-3, and D.4.2-4 (which illustrate the role of TFP and other wedges in the growth of Y/N), I find that the main conclusion remains the same as that of the baseline case. In general, TFP growth is important in the later stages of development, whereas the role of factor accumulation, especially the growth arising from the rising capital wedge, remains non-trivial in the earlier stages of development.

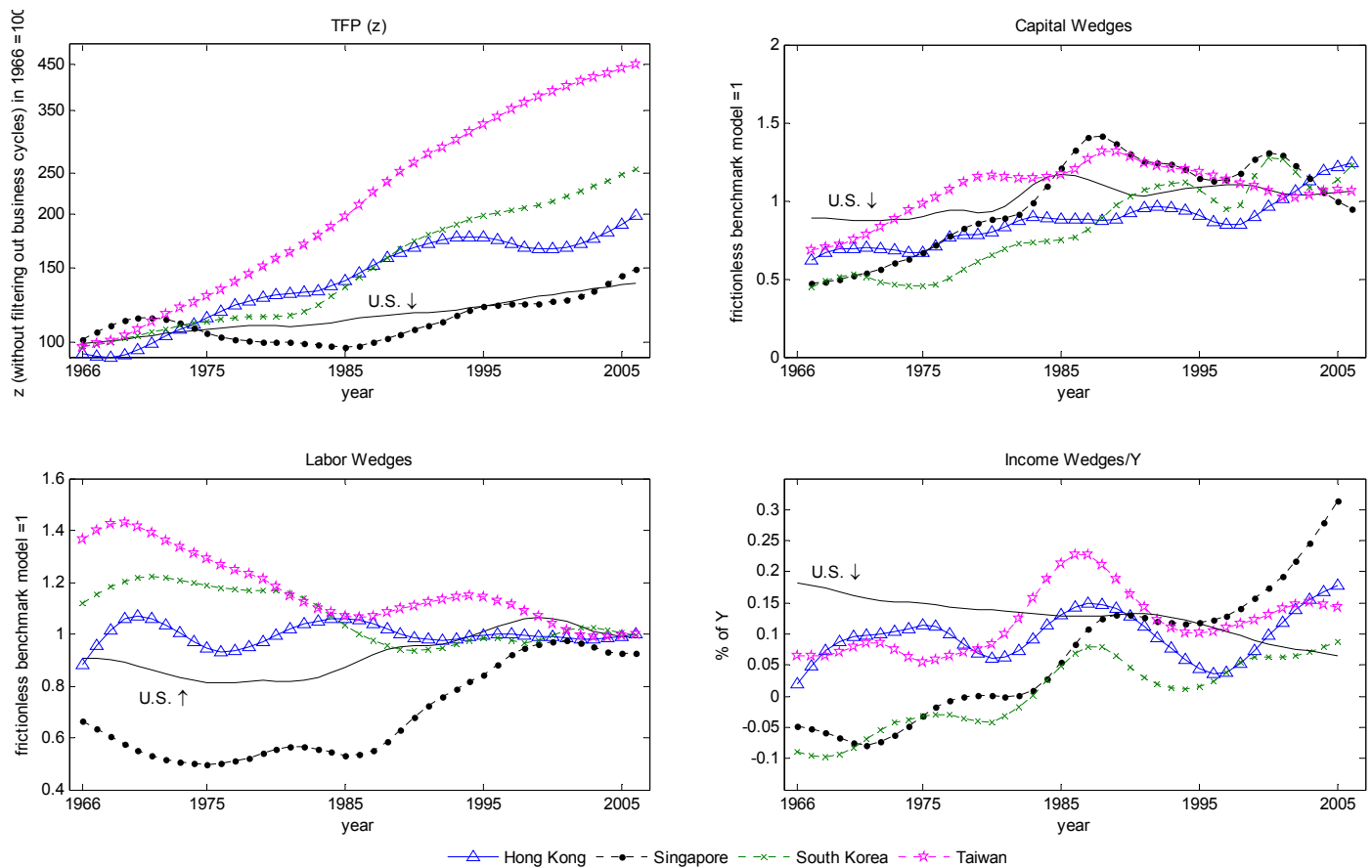


Figure D.4.2-1: Wedges for the model with country-specific parameters, with terminal condition $\gamma = 0$.
(All the wedges were filtered using the Hodrick-Prescott filter with a smoothing parameter = 6.25.)

⁸ Since the time series used for plotting Fig. D.4.2-1 were filtered using the Hodrick-Prescott filter with a smoothing parameter = 6.25, the initial value for z is not necessarily equal to 100 and the terminal values for the capital wedge and the labor wedges are not necessarily equal to one. But the original time series, which are fed into the model, possess the property that the initial value for z equals 100 and the terminal values for the capital wedge and the labor wedges equal one.

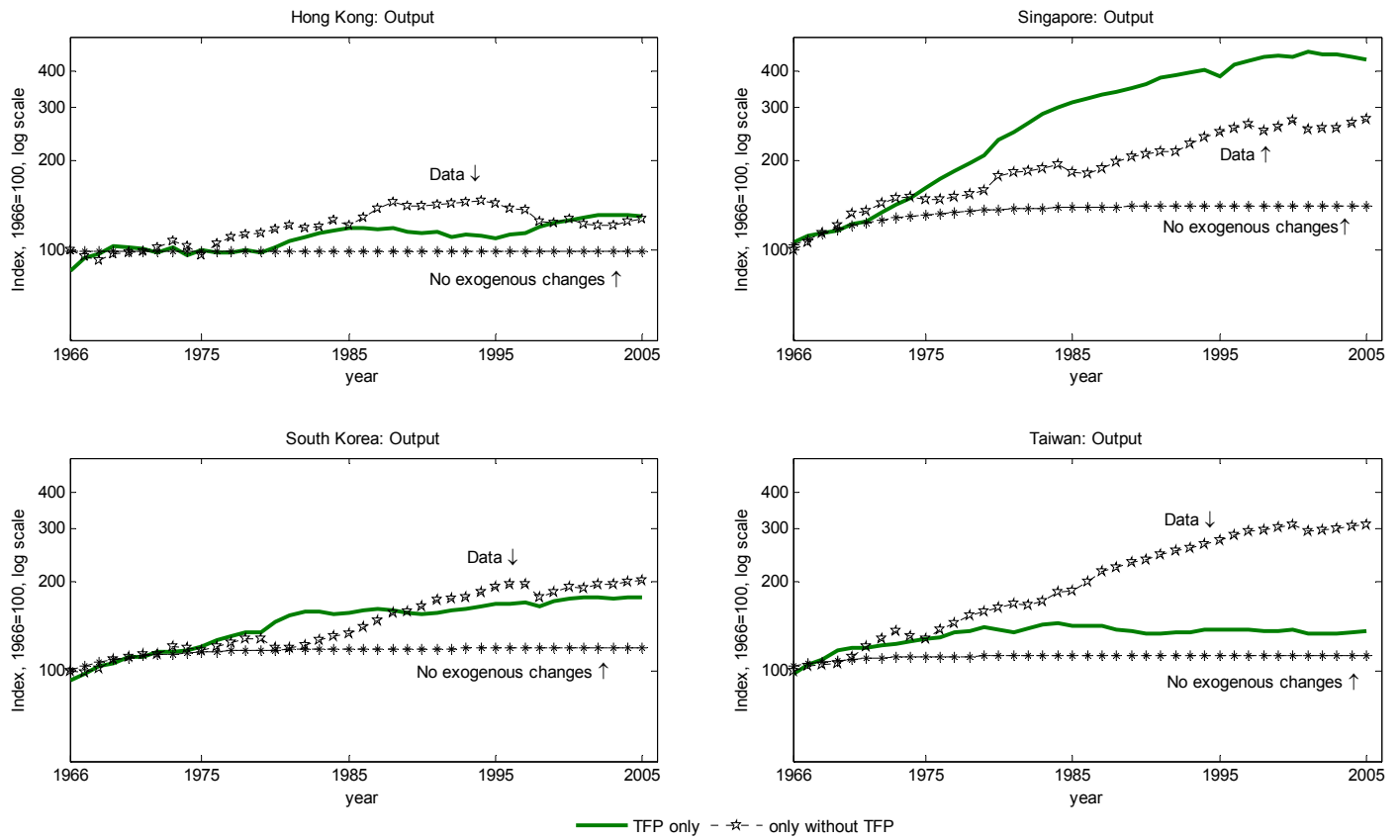


Figure D.4.2-2: (Using country-specific parameters: Y/N , detrended.): The trajectories from the models with all wedges but TFP (i.e., without TFP) versus those from the model with no exogenous changes and data (the model with four wedges).

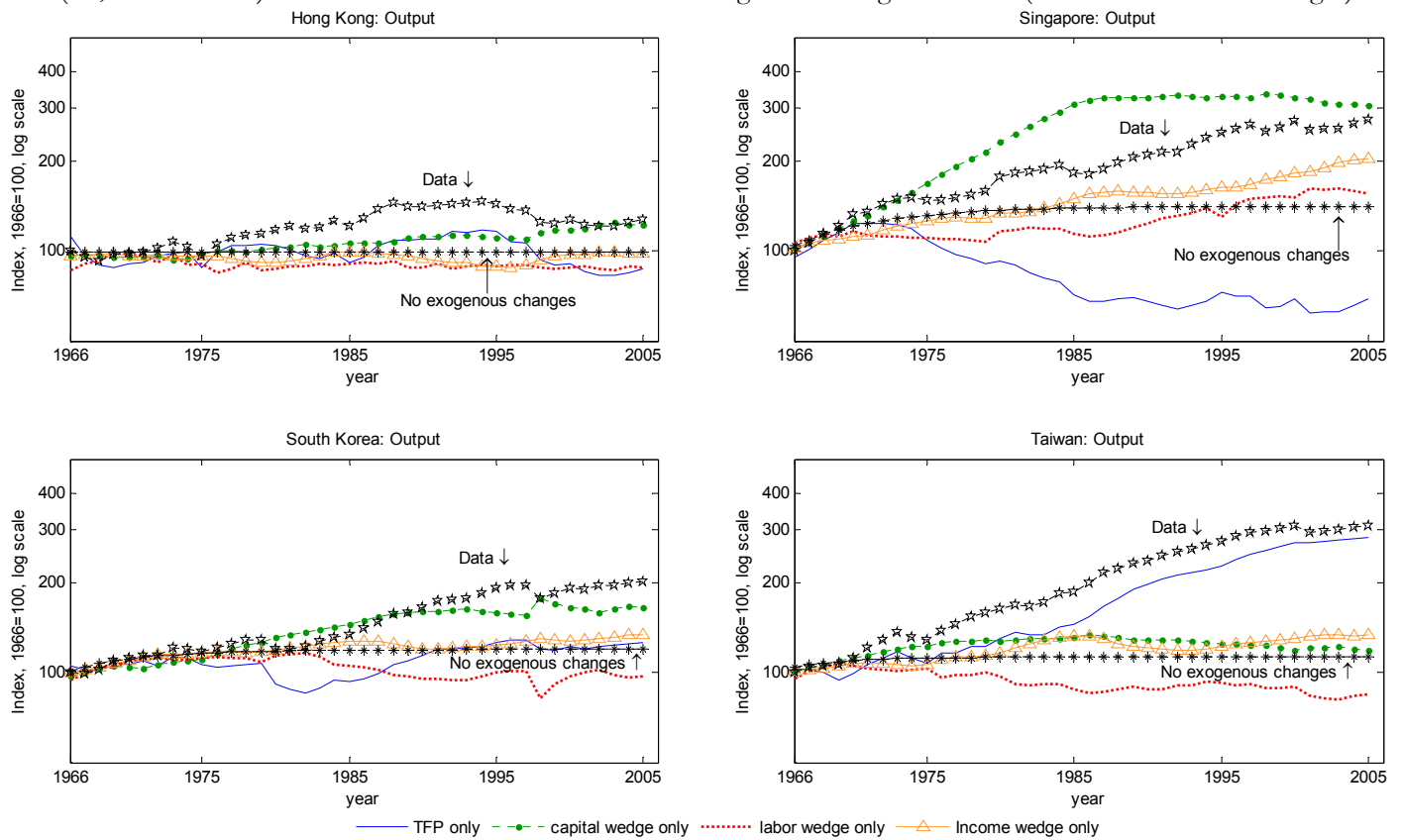


Figure D.4.2-3: (Using country-specific parameters: Y/N , detrended.): The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

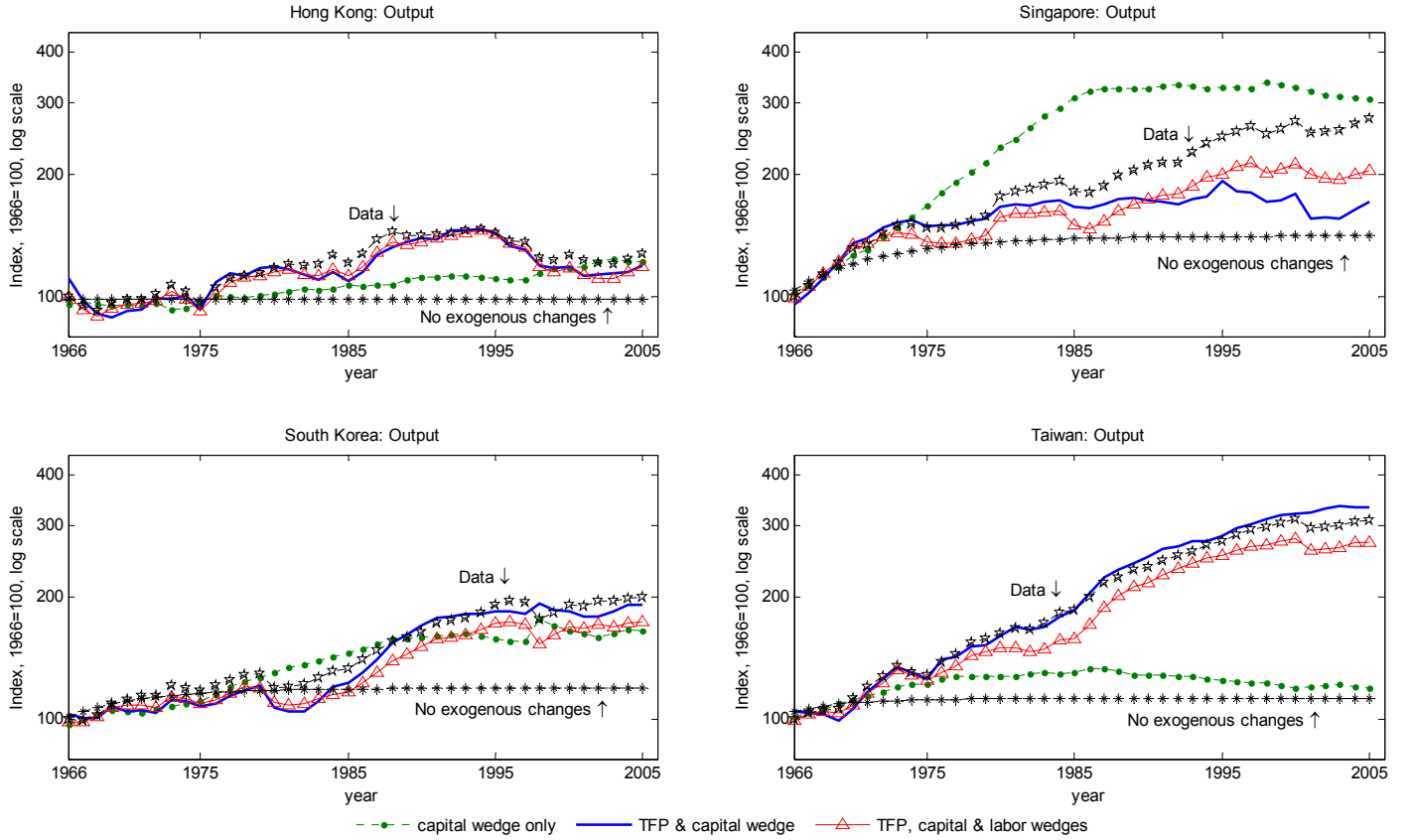


Figure D.4.2-4: (Using country-specific parameters: Y/N , detrended.): The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, TFP, the labor wedge and the income wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

D.5. Different utility functions

To address the issue of the assumption of the utility function used in the main text, I examine two alternative utility functions: (1) the log utility with linear leisure: $u(c, l) = \log c + \phi(1 - l)$; and (2) the Stone-Geary utility function: $u(c, h) = \log(c - (1 + \gamma)\bar{c}) + \phi \log(1 - l)$, where $\bar{c}$ is subsistence level. Again, I repeat the first and the second BCA step for each case.

D.5.1. Log utility with linear leisure

To allow larger fluctuations in the labor input, I chose a utility form which is linear in leisure.

The results are similar to those of the baseline case. Figure D.5.1-1 displays the computed wedges. In comparison with Fig. 2 in the main text, the key difference is that labor wedges have smaller deviations from one than in the baseline case. Consequently, the contribution of the labor wedge to growth remains insignificant (as shown by Figs D.5.1-2, D.5.1-3, and D.5.1-4 which illustrate the role of TFP and other wedges in the growth of Y/N).

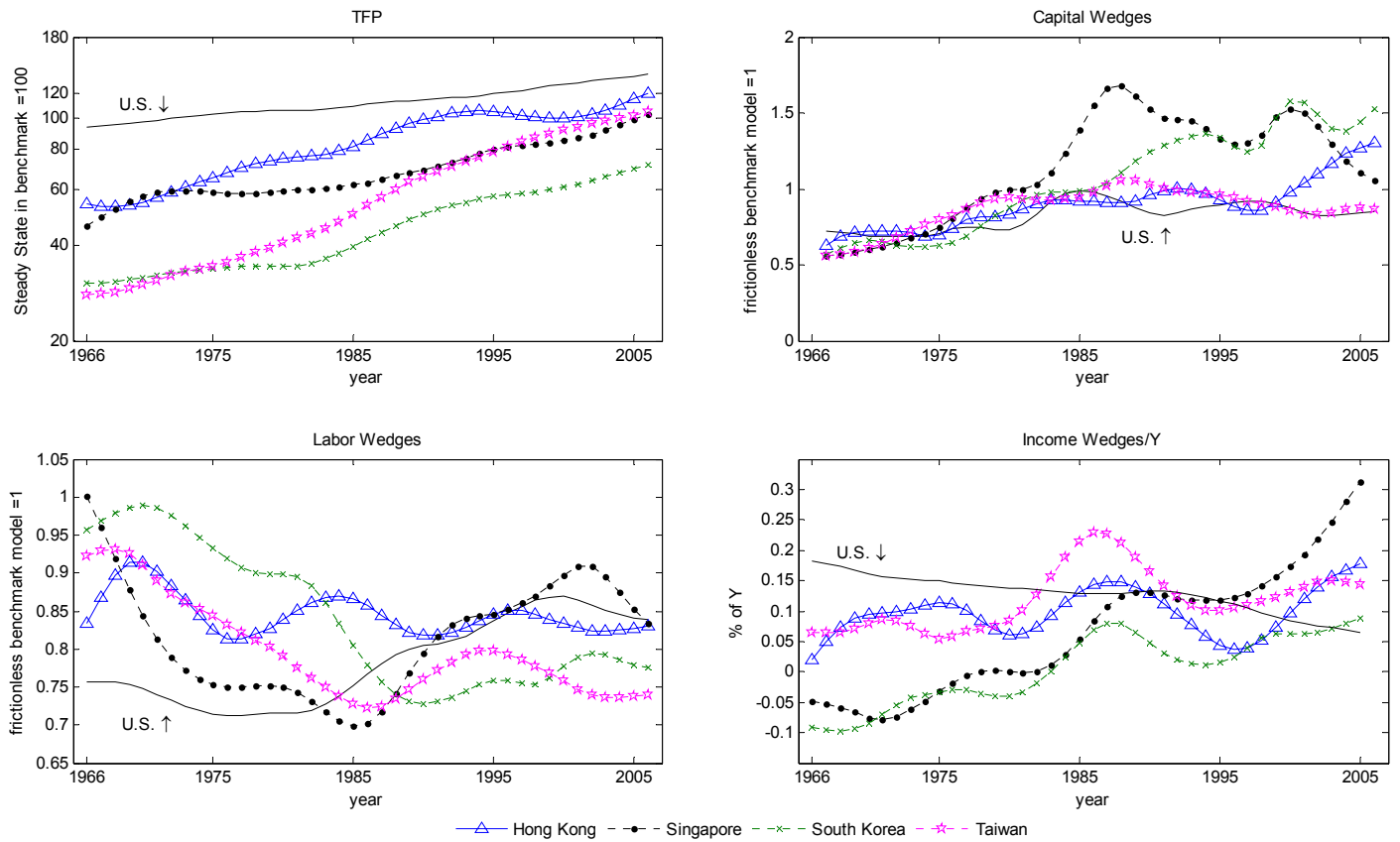


Figure D.5.1-1: Wedges for the model with utility linear in leisure, with terminal condition $\gamma = 0$. (All the wedges were filtered using the Hodrick-Prescott filter with a smoothing parameter = 6.25.)

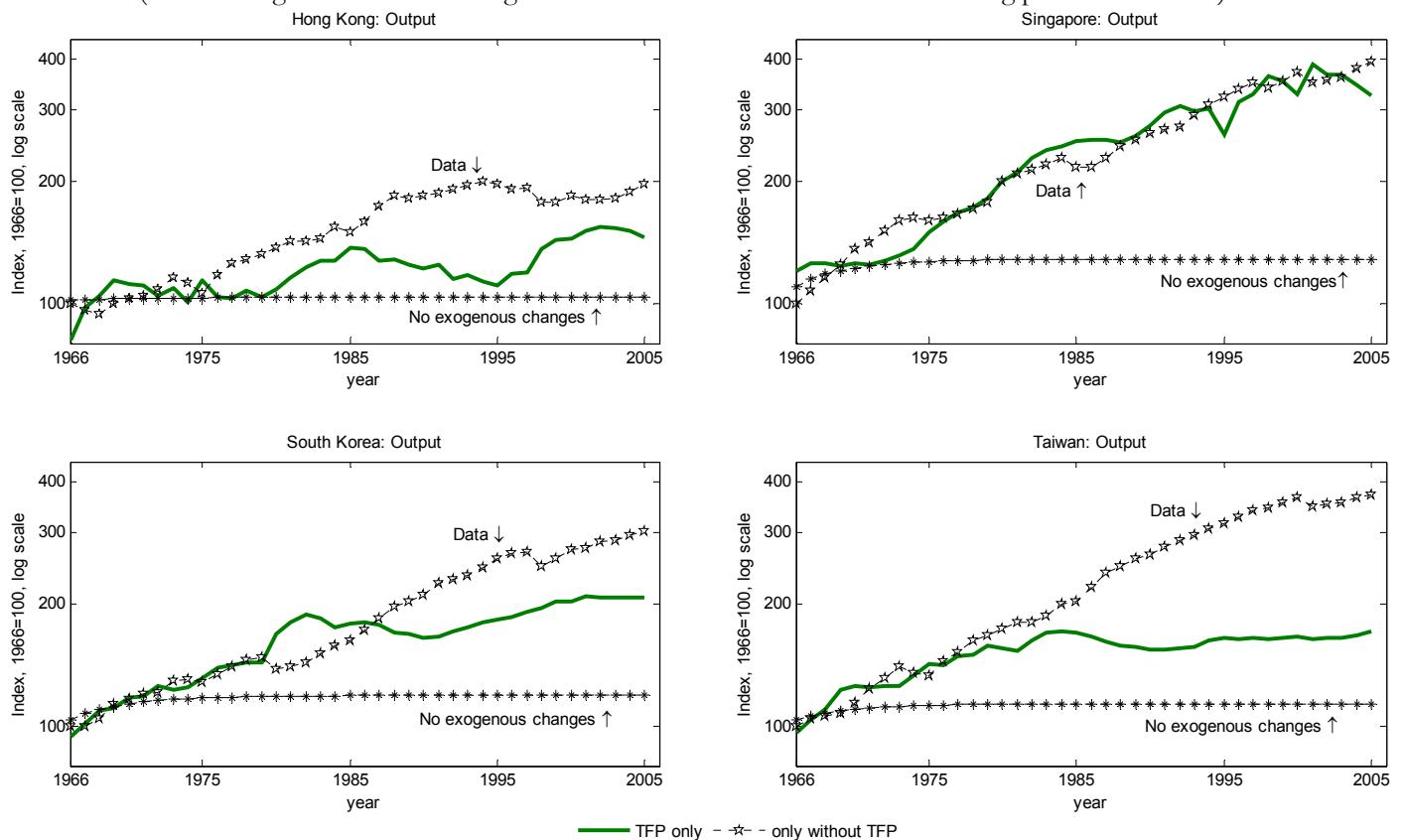


Figure D.5.1-2: (The model with utility linear in leisure: Y/N , detrended.): The trajectories from the models with all wedges but TFP (i.e., without TFP) versus those from the model with no exogenous changes and data (the model with four wedges).

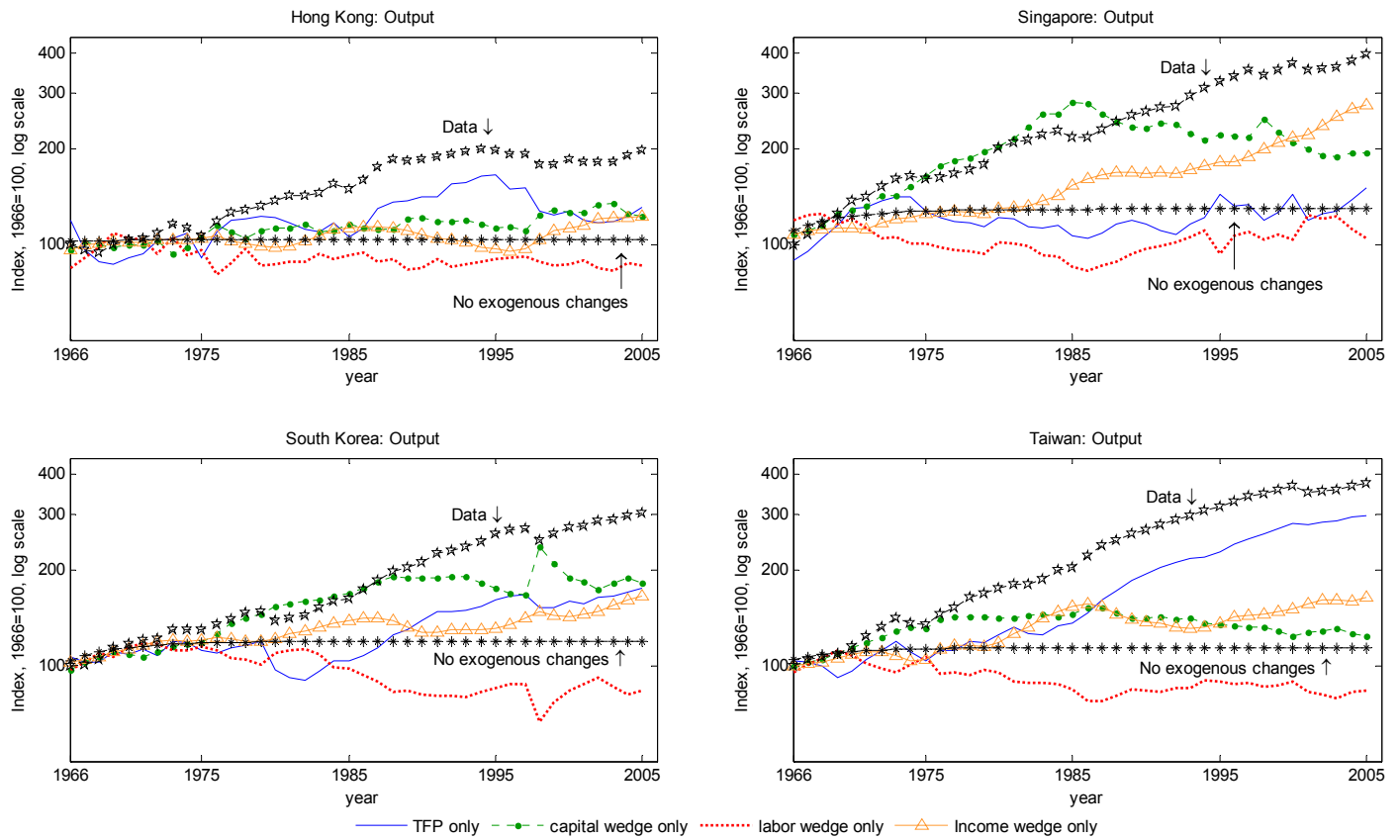


Figure D.5.1-3: (The model with utility linear in leisure: Y/N , detrended.): The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

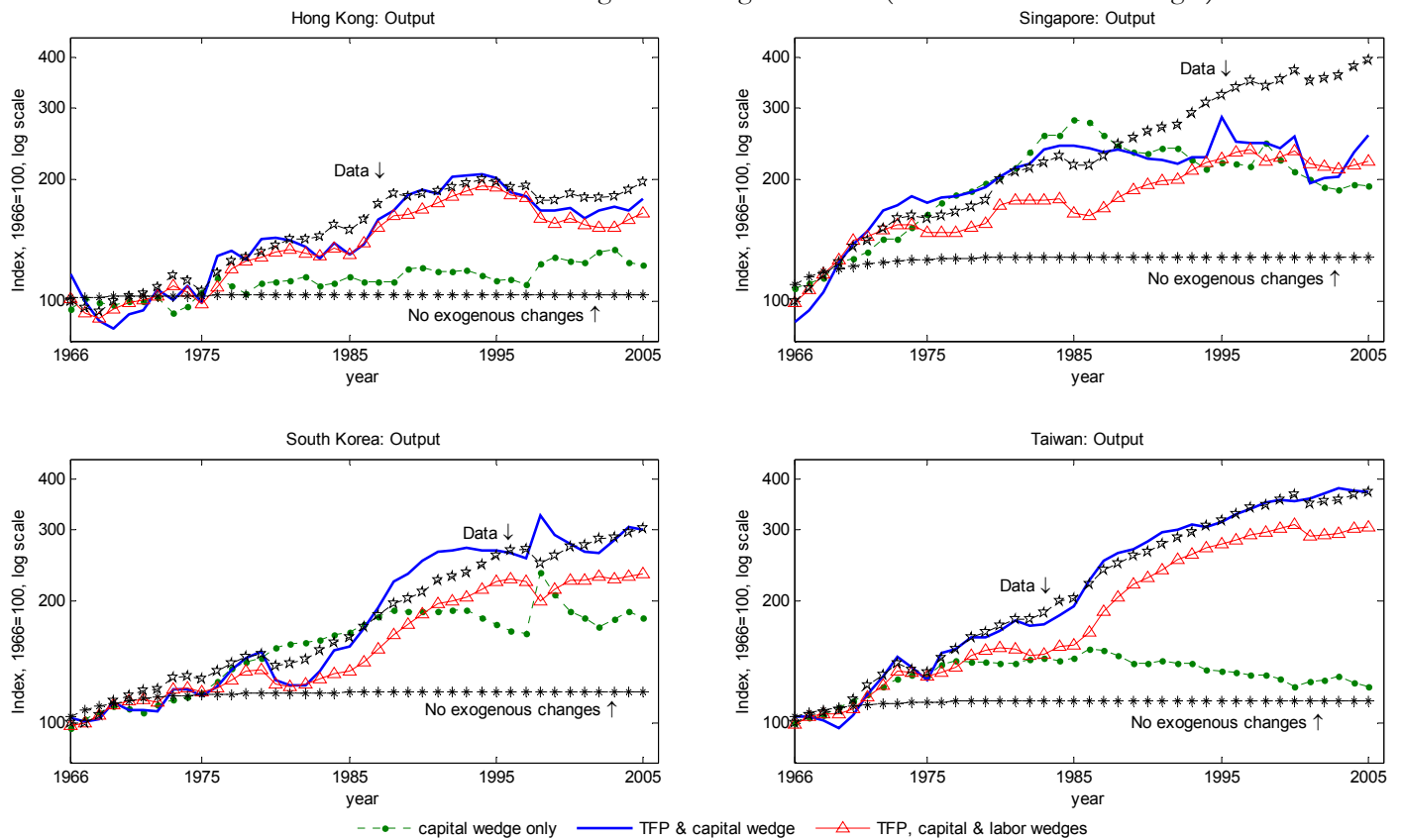


Figure D.5.1-4: (The model with utility linear in leisure: Y/N , detrended.): The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, TFP, the labor wedge and the income wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

D.5.2. Stone-Geary utility function

In order to discuss the issue of subsistence level, I adopt the Stone-Geary form of utility function to examine how the existence of subsistence level changes the wedges and the results of the simulations I have conducted for the baseline case. To pin down the subsistence level, I assume the initial labor wedge (i.e., the average for 1966-1970) to be one and then compute the subsistence level for each NIC. Then, I convert the computed levels into per working-age person in 1966 (i.e., 3,118 for Hong Kong, 2,406 for Singapore, 1,460 for South Korea and 1,332 for Taiwan). These values are the subsistence levels per working-age person ($\bar{c}$) I use for computing the capital and labor wedges.

Figure D.5.2-1 displays the computed wedges. In contrast to Fig. 2 in the main text, the Stone-Geary utility function with the calibrated subsistence level results in flatter labor wedges in the earlier stages and keeps the dramatic change in Singapore in the later stages. Moreover, the rising trend remains for capital wedges. Therefore, the existence of the subsistence level can explain the falling labor wedges in the earlier stages of development but the rising capital wedges need an additional explanation, e.g., policy changes that increase subsidies on capital returns.

Figures D.5.2-2, D.5.2-3, and D.5.2-4 illustrate the role of TFP and other wedges in the growth of Y/N . The main conclusion remains the same as that in the baseline case: in accounting for growth, rising capital wedges tend to be important in the earlier stages of development and TFP growth tends to be important in the later stages of development.

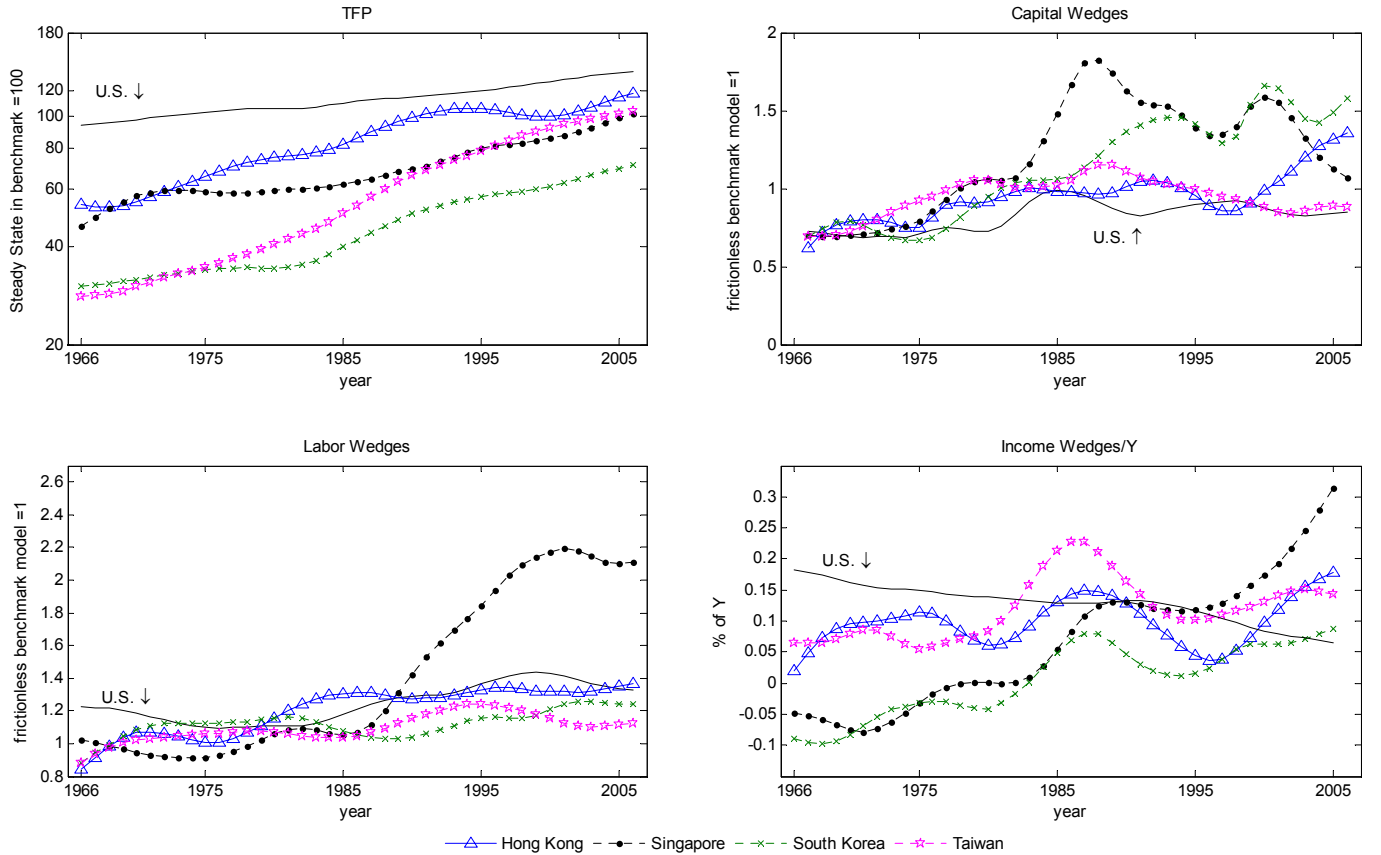


Figure D.5.2-1: Wedges for the model considering the subsistence level, with terminal condition $\gamma = 0$.
(All the wedges were filtered using the Hodrick-Prescott filter with a smoothing parameter = 6.25.)

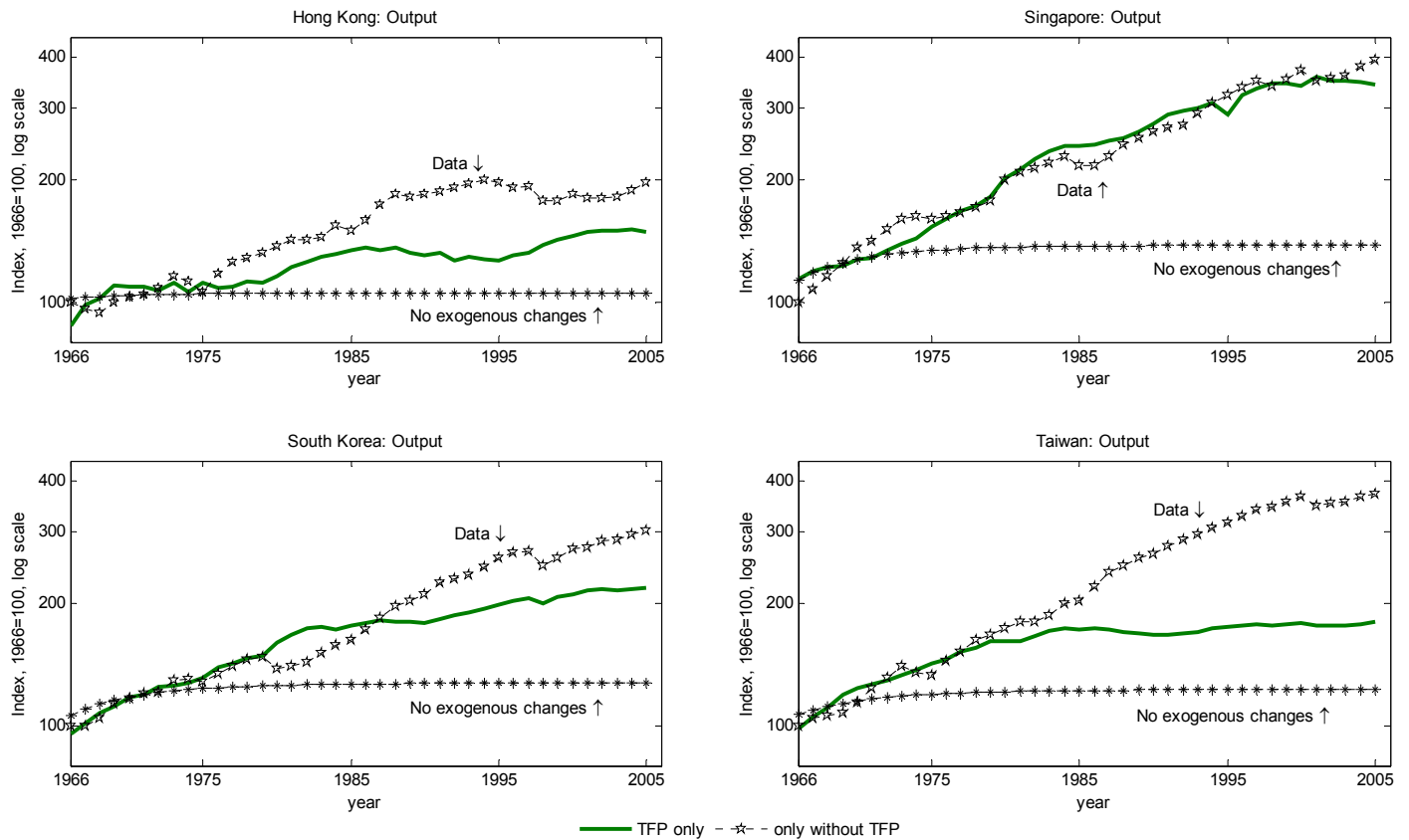


Figure D.5.2-2: (The model considering the subsistence level: Y/N , detrended.): The trajectories from the models with all wedges but TFP (i.e., without TFP) versus those from the model with no exogenous changes and data (the model with four wedges).

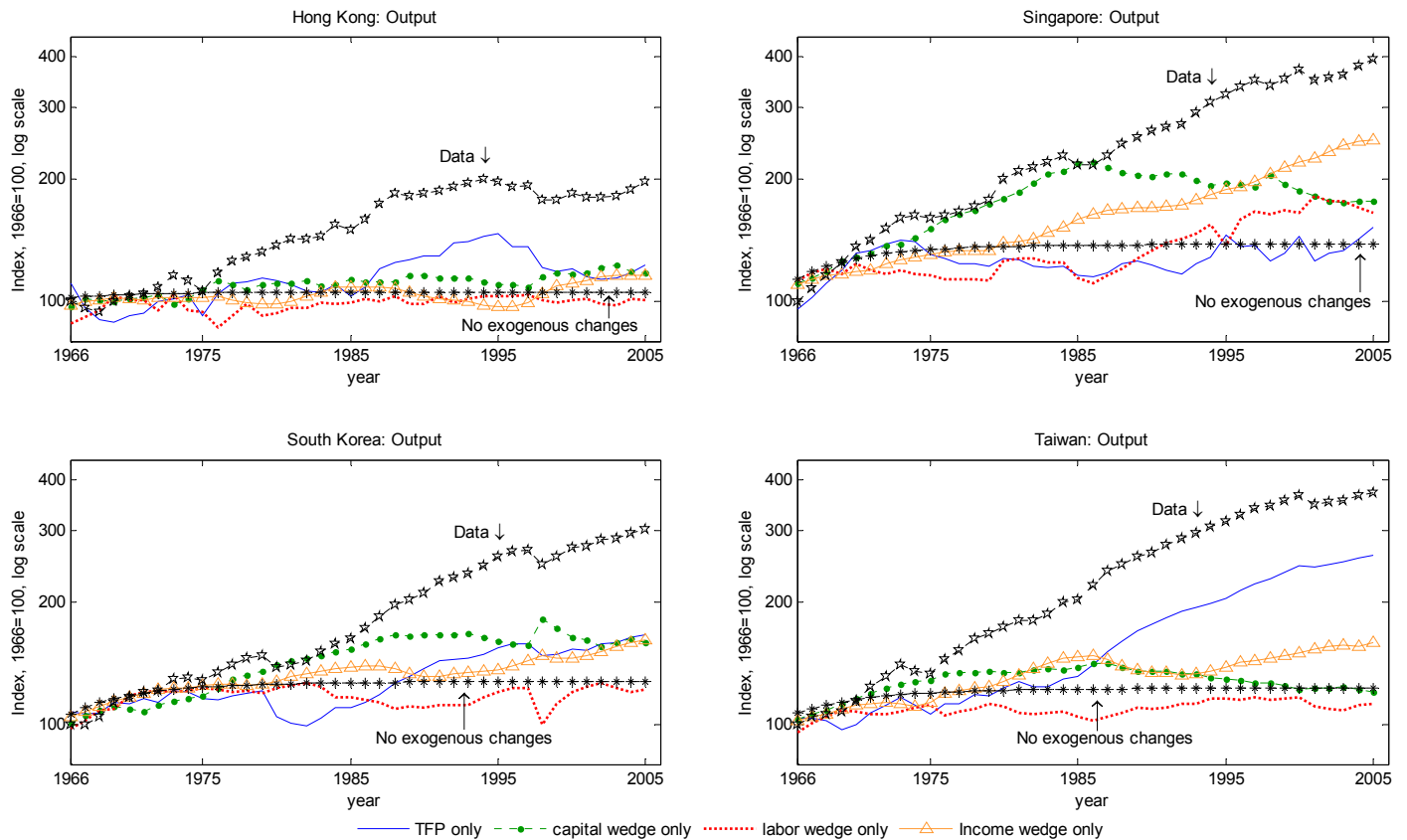


Figure D.5.2-3: (The model considering the subsistence level: Y/N , detrended.): The trajectories from models with one wedge only versus those from the model with no exogenous changes and data (the model with four wedges).

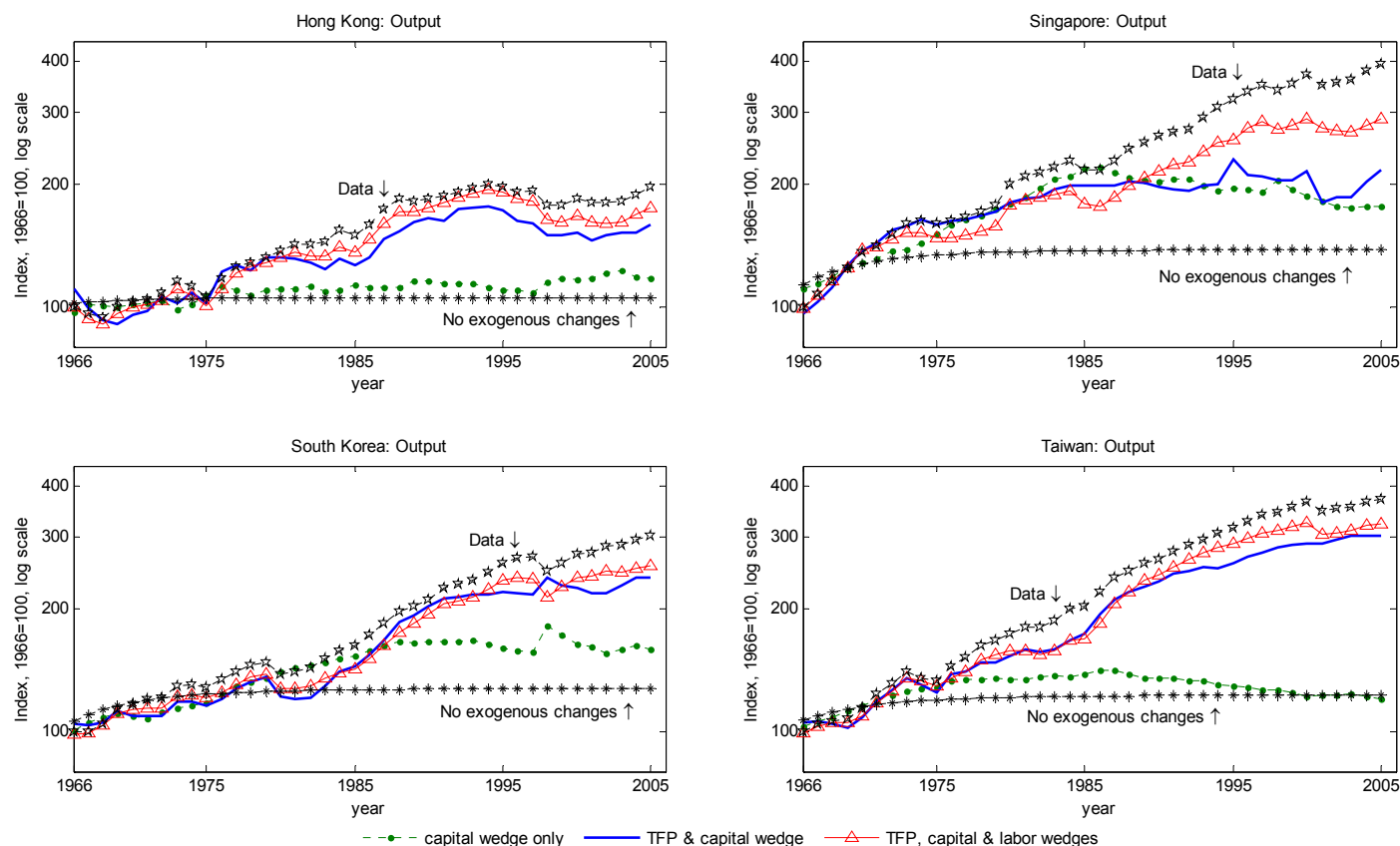


Figure D.5.2-4: (The model considering the subsistence level: Y/N , detrended.): The trajectories from the simulations that sequentially add in wedges (in sequence of the capital wedge, TFP, the labor wedge and the income wedge) versus those from the model with no exogenous changes and data (the model with four wedges).

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