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A North-South Model of Structural Change and Growth

Maria Aristizabal-Ramirez[a], John Leahy[b], Linda L. Tesar[c,*]

[a] *Federal Reserve Board, United States*
[b] *Department of Economics and Ford School of Public Policy University of Michigan & NBER, United States*
[c] *Department of Economics University of Michigan, NBER & CEPR, United States*

Abstract

This paper is motivated by a set of cross-country observations on economic growth, structural transformation, and investment rates in a large sample of countries, We observe a hump-shaped relationship between a country's investment rate and its level of development, both within countries over time and across countries. Advanced economies reach their investment peak at a higher level of income and at an earlier point in time relative to emerging markets. We also observe the familiar patterns of structural change (a decline in the agricultural share and an increase in the services share, both relative to manufacturing). The pace of change observed in the 1930 to 1980 period in advanced economies is remarkably similar to that in emerging markets since 1960. Motivated by these facts, we develop a two-region model of the world economy that captures the dynamics of investment and structural change. The regions are isolated from each other up to the point of capital market liberalization in the early 1990s. At that point, capital flows from advanced economies to emerging markets and accelerates the process of structural change in emerging markets. Both regions gain from the liberalization of financial markets, but the majority of the gains accrue to the emerging economies. The overall magnitude of gains depends on the date of liberalization, the relative sizes of the two regions and the degree of asymmetry between the two regions at the point of liberalization. Finally, we consider the impact of a "second wave" of liberalization when China fully opens its economy to capital inflows.

Keywords: Investment, Economic growth, Structural Change
JEL Classification: F21, F43

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[*] Corresponding author

Email addresses: maria.aristizabal-ramirez@frb.gov (Maria Aristizabal-Ramirez), jvleahy@umich.edu (John Leahy), ltesar@umich.edu (Linda L. Tesar)

Introduction

In response to the spate of balance of payments crises of the 1980s, then U.S. Secretary of the Treasury James Baker articulated a plan of structural reforms to promote growth in low and middle-income countries and increase their access to international financial markets. The nexus of policy reforms around fiscal and monetary discipline, privatization, and openness to foreign investment was largely endorsed by the IMF, the World Bank and the U.S. Treasury and came to be known as the "Washington Consensus" (Williamson, 2018). While there may have been a consensus about the merits of the recommended policy agenda in the early 1990s, there is less agreement today about the success of the policy agenda as it was put into practice. Critics point to evidence that the policies failed to produce a sustained increase in the rate of economic growth in low income countries (Rodrik, 2006; Goldfajn et al., 2021; Zagha et al., 2005). Further, they argue, there is evidence to suggest that those countries that reformed later, at the wrong point of their growth cycle, or with weak institutions, may lose from liberalization (see, for example, Rodrik (2016); Stiglitz (2000)). Other economists, however, are more optimistic, noting that in the period following the implementation of policy reforms, countries experienced a spurt of investment, a decline in the cost of capital and an increase in capital inflows (Chari et al., 2021; Henry, 2007). The Summer 2021 issue of the *Journal of Economic Perspectives* devotes 90 pages to a post-mortem of the Washington Consensus.

Our paper provides a reconciliation to these seemingly contradictory perspectives – at least in the evaluation of the impact of capital market liberalization – when viewed through the lens of a neoclassical model of growth and structural change. We begin by documenting patterns of investment, income and structural change in 34 countries over a span of six decades. In order to focus on the general features of rich and poor countries and avoid an overemphasis on the special experiences of a few, we split our set of countries into two groups: advanced economies (with per capita income above the sample median at the beginning of our sample) and emerging markets (those with per capita income below the median). Our first main empirical result is that prior to global capital market integration in the early 1990s, the two groups of countries follow roughly identical trajectories of growth and structural change, with the emerging markets starting later in time and at a lower level of per capita income. In both sets of countries, the investment share follows a hump shape, rising and then falling. In advanced economies, investment peaks in the mid-1970s at 26 percent of GDP. A parabola that is fitted to advanced economies for 1960 to 1991 also fits the data for emerging markets, with a rightward shift in time or a leftward shift in per capita income. Using that parabola, the model predicts that emerging markets would reach their peak investment rate at 26 percent of GDP in 1991. Most theories link the investment to GDP ratio to the structure of production across manufacturing, services and agriculture, with investment tied to the share of manufacturing. We document the changes in the composition of GDP over time in our two regions and find that these are also remarkably similar, although the transformation in emerging markets appears to lag that of developing nations by a bit longer than does the peak in investment relative to GDP. Documenting the general similarity in the development experience between advanced economies and emerging markets and the observation that investment peaks at a lower level of GDP in emerging markets are both novel contributions of this paper.

Our second main empirical result is that when we consider data from the 1990s and beyond, the investment to GDP ratio in emerging markets flattens out and remains elevated relative to the path followed by the advanced economies. This high investment rate corresponds to a period of capital market liberalization. At the same time that investment is elevated, we see a significant increase in the flow of private investment from advanced economies to emerging markets.

To better understand these patterns in the data, we develop a two-region model of the world economy. To generate the observed rise and fall in the ratio of investment to GDP we include three goods – agriculture, manufacturing and services – and model the transition from agriculture to services as the economies grow. In the model, this transition is driven both by time-varying preferences and by differences in the production structure and technological growth across sectors. Consistent with the observed similarity in development across the two regions, the model explains their development experience remarkably well with very similar specifications for the two regions. In the model, the two regions share the same technology and preferences and differ only in that the emerging market group starts its growth process at a later point in time, with a lower level of per capita income, and slightly different efficiencies at the sectoral level. While the model contains several mechanisms that potentially drive structural change, it identifies the differential rate of technological changes across sectors as the most important factor explaining the hump-shaped pattern of investment over time. Time-varying preferences and differences in factor shares across sectors play a minor role.

We assume that the regions are isolated from each other up to the point of capital market liberalization in the early 1990s. At that point, capital flows from advanced economies to emerging markets, equalizing the return on capital and pushing the emerging markets further along their growth path. In effect, capital market liberalization redistributes capital between the two regions, resulting in transitory changes in investment and output, but does not alter the underlying process of growth. In this sense, the model is consistent with what both the critics and supporters of the Washington Consensus have observed: private capital flows spur investment and lower the cost of capital, but do not produce a sustained increase in long-run growth. Consumption levels change permanently, however, due to the dynamics of borrowing in the short run and debt service in the long run.

Our model allows us to evaluate the gains from capital market liberalization. Given that we have three consumption goods, we cannot simply calculate the consumption equivalent of the policy change as is common in the literature (Lucas, 1987). Instead we calculate both the equivalent variation and the compensating variation that together place bounds on the welfare gains or losses. We find that both regions gain from the liberalization of financial markets, but the majority of the gains accrue to the emerging economies. The overall magnitude of the gains depends on the date of liberalization, the relative sizes of the two regions and the degree of asymmetry between the two regions at the point of liberalization. Emerging markets prefer to liberalize earlier, and their share of the gains is larger the earlier the date of liberalization. This makes intuitive sense, as the gains from liberalization are greater the larger the difference between the cost of capital in the two regions, and this difference shrinks as the two regions converge toward their long-run steady-state. Following liberalization, manufacturing production increases in the advanced economies. Over time manufacturing shifts to the emerging markets as they pay off their debt.

Our group of emerging markets does not include China. For most of the sample, China plays a minor role in the world economy, but this role has grown quite significantly as of late. We include China in our model as an untapped investment opportunity available to global investors. We perform a counterfactual in which China allows unfettered private investment inflows in 2017. Given our assumption that the marginal product of capital in China at the point of opening is higher than the prevailing global interest rate, the gain from this new investment opportunity is unambiguously positive for advanced economies. The impact on emerging markets, however, is more nuanced. Those that enter this second wave of liberalization encumbered by debt from the first liberalization may actually suffer a welfare loss, as the cost of debt service exceeds the gains from investing in China. In this analysis, the emphasis is on the differential impact that new opportunities have on countries depending upon whether they are net borrowers or net lenders. It abstracts from other aspects of China's impact on the world economy such as its large footprint in manufacturing trade and the impact of China's savings rate on the level of the world interest rate.

Related literature

A key contribution of our study is to develop a quantitative model that is consistent with the dynamics of saving, capital accumulation, and sectoral shares within countries, as well as with the global allocation of investment in emerging and advanced economies. Our model builds off the work of Echevarria (1997), one of the earliest quantitative models of structural transformation in a closed economy. Her model combines the two mechanisms that have proved important in the subsequent literature. The first mechanism works on the demand side by assuming that preferences are non-homothetic. Non-homothetic preferences help explain patterns of expenditure as income rises, in particular the shift in spending from agricultural goods to manufacturing and services. Such preferences take many forms. Kongsamut et al. (2001) and Moro (2015) use Stone-Geary preferences, Foellmi and Zweimüller (2008) use hierarchical preferences, and Comin et al. (2015) use generalized CES preferences. Boppart (2014) uses the class of price independent generalized linearity preferences. We capture these non-homotheticities by assuming that preferences are time varying and converge to Cobb-Douglas.

The second mechanism works on the supply side. Echeverria allows for differences across sectors in the rate of technological progress and factor intensity in production. Both of these mechanisms can lead to trends in relative prices that can, in turn, shift demand across sectors. Both supply-side and demand-side mechanisms can generate hump-shaped dynamics in the share of manufacturing production in output. Ngai and Pissarides (2007) emphasize differences across sectors in TFP growth, while Acemoglu and Guerrieri (2008) explore differences in factor utilization. Alvarez-Cuadrado et al. (2017) consider differences in substitutability between capital and labor. Herrendorf et al. (2015) fit a model with all three supply-side mechanisms to US data. We follow Echevarria (1997) and include both differences in TFP growth and differences in factor intensity.

The literature on structural change and economic growth is extensive (see Herrendorf et al. (2015) for a review) and much of the work on growth has tended to treat each country as a closed economy or, if open, trade is assumed to be balanced. Our contribution is to study growth and structural change in an environment with integrated financial markets. Seminal work in this area includes Ventura (1997) and Matsuyama (2009), who construct theoretical models that illustrate how structural transformation in open economies may differ from structural transformation in closed economies. Much of the recent work has focused on explaining the sustained growth of East Asian economies, in particular Korea (Uy et al., 2013; Cai et al., 2015). Many of these papers assume balanced trade and abstract from capital accumulation (Uy et al., 2013; Świkecki, 2017; Sposi, 2019). Recently, Kehoe et al. (2018) develop a global model of structural change with non-homothetic preferences, and multiple sectors to explain the decline of the US employment in manufacturing.

Our paper also contributes to the literature on market liberalization, capital flows and growth. Ravikumar et al. (2019) study trade liberalization, capital flows and growth in a multi-country model with a single consumption good and a variety of tradable intermediate goods. They find intertemporal trade is the cause of much of the welfare gains from market integration. Reyes-Heroles et al. (2018) find that lower trade costs play an important role in structural change in the United States. They find that lower trade costs shifted comparative advantage against manufacturing in the US. In contrast, our model predicts that financial market liberalization initially promotes manufacturing in advanced economies as capital finds productive uses in emerging markets. Over time, however, emerging markets need to pay off their debt and their manufacturing exports crowd out domestic production in advanced economies. Sposi et al. (2021) deserves special note. Like our paper, they consider a multi-country model of growth and sectoral change which they fit to a sample of 28 countries. They find that sector-based productivity growth alters relative prices and helps to explain deindustrialization in some emerging economies. Their study complements ours nicely. Whereas we focus on intertemporal trade and shut down comparative advantage, they focus on comparative advantage and assume intertemporal trade is largely exogenous. Capital flows are the main mechanism linking regions in our model. Opening financial markets allows capital to seek higher returns thereby promoting growth and accelerating the process of structural change. Technological progress is exogenous in our model. One can also imagine growth and structural change being driven by technology transfer. Fujiwara and Matsuyama (2020) explore such a model. In their model, there is no trade. Growth and structural changes arise as emerging economies adopt technologies developed by advanced economies.

The facts that motivate our study have predecessors elsewhere. The pattern of structural change is well known. The hump-shaped pattern at the investment rate has been noted by Echevarria (1997), Acemoglu and Guerrieri (2008), and Garcia-Santana et al. (2016). Although they do not specifically look a the investment rate, Rodrik (2016) and Fujiwara and Matsuyama (2020) argue that many emerging economies industrialize and de-industrialize at lower levels of GDP per capita than did advanced economies. What is new is our attempt to deal with all of these observations in a single setting and to explain the role of capital market integration on long-run growth paths.

1. Four Facts describing Investment, Economic Growth and Structural Change

In this section we establish four key facts describing the process of economic growth and structural transformation in a large sample of countries focusing mainly on the post-WWII period. We will return to these four facts in Section 4 to evaluate how well our model performs in explaining growth and sectoral change over time and across countries.

Our sample includes 34 countries. Together, these countries account for 82 percent of world GDP and 95 percent of world investment in 1960. We draw information from the Penn World Table 9.1, the World Bank: World Development indicators (WDI)[1], the Maddison Project Historical National Accounts for the period 1930-1960, and the Federal Reserve Bank of St. Louis (FRED). Details regarding data sources and data construction are available in the online appendix A.

We group countries into two regions based on per capita income in 1950. We place the rich countries into Block A, the global "North" in North-South models of growth and development, and the poor countries into Block B, the "South". We choose to group countries for two reasons. One is theoretical. A two-region model delivers greater analytic clarity and tractability. The second is empirical. We wish to focus on the common trends that differentiate these groups rather than the idiosyncratic heterogeneity that is surely present.

[1] http://worldbank/org/data-catalog/world-development-inidcators

We comment throughout how these common trends relate to the individual experiences of various nations. We also consider several extensions of our model that incorporate heterogeneity in simple ways. The cost to our approach is that we abstract from differences across developing countries, especially differences between Latin America and East Asia that are the focus of other studies.

We choose to group nations based on income because income is the single most informative variable with regard to development. We do not want to sort countries based on the facts described below, because we want to show that these characteristics are characteristics of rich as well as poor nations. The one exception to the general rule is Japan, which was relatively poor following WWII, but grew very quickly thereafter. As Japan looks more like a rich country for most of the sample, we include it in Block A. Where appropriate we discuss the sensitivity of our results to the assignment of countries to the two Blocks. The main place that this matters is in the welfare results of Section 5.

Block A includes: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom, and United States. Block B includes the following emerging markets: Argentina, Brazil, Chile, Greece, India, Indonesia, Ireland, Malaysia, Mexico, Poland, Portugal, South Korea, Spain, Taiwan, Thailand, and Turkey. China is the most important country missing from this list. We do not include China in our initial model because for most of the sample it was not a market economy. In section 6, we consider the implications of integration with China for the global allocation of capital and welfare.

Where possible we define region level variables as the sums or averages of country level variables. Missing observations occasionally create complications. Details regarding the aggregation of country level observations to the block level are contained in online appendix.

The first feature of the data we wish to highlight is the hump-shaped pattern in investment rates, both within countries over time and across countries. Figures 1a through 1d illustrate the evolution of the investment rate in Block A as real per capita income (PPP adjusted) rises over time. Each circle corresponds to an investment rate for a single country i in year t. Figure 1a shows investment rates for the early part of our sample (the decade 1950 to 1960), with the last observation of the decade as the darker circle, identified with a country label. This illustrates an increase in investment rates along with the increase in real per capita income. Figures 1b, 1c, and 1d extend the sample through 1980, 2000 and 2017 respectively. The circles become darker with each decade over time, and the darkest circles depict the last observation. The investment rates trace out a parabola that peaks in 1975 at a real per capita income of $19,000 (in PPP adjusted terms). This nonlinear relationship between investment rates and income, rising at low levels of income and then declining at higher levels of income, has been noted in other studies (see, for example, Echevarria (1997), Acemoglu and Guerrieri (2008), and Garcia-Santana et al. (2016)).

The hump-shaped pattern in investment rates observed for Block A is also observed in Block B. Figure 2 plots the investment rate for each region against time. The blue dots indicate the investment rate in Block A in each year. The solid blue line is a parabola fitted to these points. The red dots and the dotted red line depict the investment rate in Block B. Each region has a hump-shaped pattern in investment. The rise and fall in each block has a similar shape. The main difference is that the rise and fall in Block B occurs later in time. This is suggestive that the two groups of countries follow a similar investment trajectory as they grow, but they start at different points in time. Table 1 makes these points precise. The table provides summary statistics on investment and income in the two regions. The first column shows that the fitted parabolas peak at very similar investment rates. The third column shows that this peak occurs two decades later in Block B.

The similarities illustrated in Figure 2 mask two important differences between the blocks. The first important difference is that, whereas Block B peaks later in time, it peaks at a lower level of per capita income. Figure 3 transforms the x-axis in Figure 2 replacing each year with per capita (PPP adjusted) income in that year. Again the curves represent parabolas fitted to the data. As is clear in the figure, investment peaks at a higher level of level of per capita income in Block A.

The hump-shape in investment is not a feature of simple models of economic growth such as the Solow or Ramsey model. I/Y is constant in the Solow model and constant along the balanced growth path in the Ramsey model. If the capital stock begins below steady-state, then the investment rate declines over time and with income in the Ramsey model. The literature on structural transformation looks at shifts in supply and demand across sectors to explain the hump-shape in manufacturing and investment. A declining price of capital can explain an increase in the investment rate over time.

The second important difference between the regions is that the humps, while very similar, are not exactly the same shape. Figure 4 reproduces Figure 2, but instead of fitting a parabola to the investment rates for Block B, we translate the parabola from Block A until it fits Block B's data over the 1960 to 1991 period. While the new curve fits the data well over this period, it underpredicts investment in the years that follow. This indicates that Block B followed a trajectory very similar to that of Block A until around 1991. Thereafter investment in Block B has been slightly higher than predicted by Block A's experience.

This period of relatively high investment in Block B coincides with an increase in capital flows from Block A to Block B. There was a surge in private capital flows from Block A to Block B in the mid- to late-1990s. Figure 5 plots private capital inflows (FDI and net portfolio investment) from Block A to Block B as a share of GDP (dark line, right axis) and the volume of direct and portfolio investment flows into Block B countries in Asia, Emerging Europe and Latin America (bars, left axis). As a consequence of the general liberalization of financial markets and the reduction in barriers to capital flows, Block B economies experienced a large increase in private foreign investment. In Section 6, we will show that this investment shifted the growth path of Block B economies, initially increasing the investment rate but requiring a higher level of manufacturing output in the long run to service its external debt.

Figure 6 plots the shares of agriculture, manufacturing and services in GDP for Block A between 1930 and 2017 period, and for Block B over the 1960 to 2017 period. Outside of the period around World War II, the figure captures the steady increase in the service sector as a share of GDP over time and the decline in agriculture. In Block A the manufacturing share rises until until 1980 and declines thereafter. In Block B the manufacturing share also rises and then declines slightly. Note that in each case the peak in manufacturing roughly corresponds with the peak in investment. It is instructive to compare Blocks A and B at similar stages of development. Figure 7 plots the sectoral shares for both regions with date zero for Block A being 1930 and date zero for Block B being 1960. The sectoral shares in the two Blocks are almost identical at the beginning and the end of these two periods. Much of the deviation between the shares in the two blocks is associated with World War II and its aftermath. This similarity in experience is suggestive that the two regions are on a similar growth path, with Block B starting about three decades later than Block A.

To summarize, the four facts we want to explain are (i) investment rates exhibit a hump-shaped pattern, over time and with real income, (ii) investment peaks at a later date and at a lower level of real per capita income in Block B relative to Block A, (iii) both blocks experience structural transformation with a decline in the agricultural share roughly offset by an increase in the services share, and, like the hump in investment, this transformation occurs later in Block B relative to Block A, and (iv) Block B experiences a surge of private investment from Block A prior to its investment peak, which appears to be related to higher investment in Block B relative to what would have been predicted from the experience of Block A.

2. Model

We construct a model of growth and structural transformation that is consistent with the data both within and across countries, and captures the shifts in investment that occur with capital market integration. The global economy is comprised of two regional economies, corresponding to the two Blocks in the previous section. Each regional economy has three sectors: agriculture, manufacturing, and services. Agents in each region choose consumption of the three goods, the allocation of capital and labor across the three sectors, and total capital investment to maximize the present value of utility. Structural transformation is generated in two ways: total factor productivity in each sector grows at a different rate and preferences are time-varying. In the latter we follow Echevarria (1997) and add additional terms to an otherwise homothetic utility function. We parameterize these terms so that the model convergences to a balanced growth path in the long run.

We attempt to keep the regions as similar as possible. In the end the two regions differ in four ways. To capture the fact that structural transformation and the peak of the investment hump in Block A occur earlier in time, we assume that Block A is further along in the development process in the sense that its productivity is higher and its preferences are closer to the long-run balanced growth path. Second, we allow the level of productivity in each sector to differ. In the data Block B is less productive than Block A at a similar level of development. Allowing for this difference helps the model match the fact that the hump in investment occurs at a lower level of per capita GDP in Block B. Third, each region has a different initial capital stock. This allows us to match the data at the beginning of our sample in 1960. Finally, the two regions differ in their size. Relative size will affect the way in which the impact of financial liberalization is distributed across the two Blocks. In all other aspects the two regions are identical.

We allow for interactions between the two regions. We assume the manufactured good is traded but agriculture and services are produced and consumed locally. This is consistent with the fact that most trade between Block A and Block B is in manufactured goods.[2] Because there is a single manufactured good in the model, all trade is intertemporal trade.[3] In the beginning of the sample, capital markets are closed so, in effect, each region functions

[2]Online appendix B shows that 70% of trade between Blocks A and B during 2000-2014 occurs in the manufacturing sector. Block A exports 1.8 % of GDP to Block B, and imports 1.4% in manufacturing, while Block B exports 5.8% of GDP to Block A and imports 7.4% in manufacturing.

[3]In this sense our model complements the work of Sposi, et al. (2021). Their model focuses on shifts in comparative advantage and simplifies the intertemporal elements.

as a closed economy. When capital markets in Block B liberalize, capital flows from Block A to Block B. The model incorporates adjustment costs in the accumulation of capital and in the accumulation of debt in order to slow the flow of capital between A and B.

We now present the model in detail.

2.1. The regional economies

Time is discrete and indexed by $t = \{0, 1, 2, \dots\}$. There are two regions labeled $i = \{A, B\}$. There are three sectors labeled $j \in \{a, m, s\}$ where a is agriculture, m is manufacturing and s is services. Each good is produced with capital and labor using a Cobb-Douglas production function. Capital is produced by the manufacturing sector. The sectoral production functions are:

$$Y^i_{at} = A^i \mu^{t-\bar{t}_i} (K^i_{at})^{\theta} (L^i_{at})^{1-\theta} \tag{1}$$

$$Y^i_{mt} = B^i \lambda^{(t-\bar{t}_i)(1-\gamma)} (K^i_{mt})^{\gamma} (L^i_{mt})^{1-\gamma} \tag{2}$$

$$Y^i_{st} = C^i \nu^{t-\bar{t}_i} (K^i_{st})^{\phi} (L^i_{st})^{1-\phi} \tag{3}$$

There are several things to note about these functions. First, they incorporate two of the main supply-side mechanisms for structural transformation. Productivity growth (μ, λ, ν) is sector specific as in Ngai and Pissarides (2007), and factor intensity $(\theta, \gamma, \varphi)$ is sector specific as in Acemoglu and Guerrieri (2008). While these two sets of parameters differ across sectors, we assume that they are the same across the two regions. Second, the level of productivity may differ across regions. This is captured by the exponent $t - \bar{t}_i$. One can think of $\bar{t}_i$ as the date at which the region began the development process. A lower $\bar{t}_i$ means that the region has been growing for longer. Third, sectoral productivity may differ across regions. This is the role played by A^i, B^i, and C^i. This will allow us to match the fact that manufacturing is relatively less productive in Block B.

Given the total supply of capital and labor in the economy, firms in each sector employ capital and labor to maximize profits. As there are no state variables in the firm's problem, profit maximization is static. Let P^i_{jt} denote the price of good j in region i at date t. We will take the manufacturing good to be the numeraire, $P^i_{mt} = 1$.[4] Let W^i_t and R^i_t denote the real wage and the real rental price of capital respectively. The firm's problem for agriculture becomes

$$\max_{K^i_{at}, L^i_{at}} P^i_{at} Y^i_{at} - W^i_t L^i_{at} - R^i_t K^i_{at}. \tag{4}$$

The problems for manufacturing and services take similar forms.

In each region there is a representative consumer that receives utility from the consumption of the three goods. The consumer maximizes the present discounted value of utility

$$\sum_t \beta^t U^i_t \tag{5}$$

where β is the discount factor and the period utility U^i_t takes the form:

$$U^i_t = \sum_{j \in \{a,m,s\}} \alpha_j \ln(C^i_{jt}) - \epsilon^i_{jt} C^i_{jt} \tag{6}$$

The second term generates changes in the pattern of consumption over time, one of the drivers of sectoral change in the model. To capture the effect of preferences on structural transformation, we assume that the impact of this second term declines over time as preferences adjust towards steady-state:

$$\epsilon^i_{jt} = \rho_j \epsilon^i_{j,t-1} \tag{7}$$

As the ϵ^i_{jt} converges to zero, preferences converge to the familiar Cobb-Douglas form that is consistent with balanced growth.

Modeling the non-homothetic term as a function of time simplifies the computation of the steady-state in our model with two open economies. ϵ^i_{jt} acts very much like a taste shock. In contrast, much of the literature on structural change relates these non-homotheticities to

[4]When the economies are closed $P^i_{mt} = 1$ is a normalization. When the economies are open, this is both a normalization and the result of free trade in manufactured goods and the absence of trade frictions.

the level of consumption. Since consumption typically increases with time in our model, these two approaches are isomorphic except at times of liberalization. We return to this point when we discuss the impact of capital market liberalization.

The consumer owns the capital stock. The consumer's budget constraint is

$$\sum_{j\in\{a,m,s\}} P^i_{jt}C^i_{jt} + K^i_{t+1} + D^i_t = W^i_t L^i_t + R^i_t K^i_t + (1-\delta)K^i_t + \frac{D^i_{t+1}}{1+r_t} - G(K^i_{t+1}, K^i_t) - H(D^i_{t+1}, D^i_t) \tag{8}$$

There are several things to note about this budget constraint. Investment is equal to $K^i_{t+1} - (1-\delta)K^i_t$ and has a price equal to one since it is in terms of the manufactured good. The function $G(K^i_{t+1}, K^i_t)$ is a capital adjustment cost. There is a single international bond that pays one unit of the numeraire in the following period. D_t represents borrowing in this bond and r_t is the net interest rate. $H(D^i_{t+1}, D^i_t)$ is a portfolio adjustment cost. Both G and H are in units of the manufacturing good.

The two adjustment costs take the following forms :

$$G(K^i_{t+1}, K^i_t) = \frac{\psi_1}{2}\frac{\left(K^i_{t+1} - K^i_t\right)^2}{K^i_t} \tag{9}$$

$$H(D^i_{t+1}, D^i_t) = \frac{\psi_2}{2}\frac{\left(D^i_{t+1} - D^i_t\right)^2}{\lambda^t} \tag{10}$$

Note that the portfolio adjustment cost is symmetric so that the cost of increased borrowing is the same as the cost of increased lending. This symmetry implies that when the regions are open to intertemporal trade, the two regions will each face the same intertemporal marginal rate of transformation. Note also that when the economies are closed $D_t = 0$ and H and its derivatives are all equal to zero. In this case the international bond becomes a domestic bond in zero net supply.

r_t is the world interest rate (also in terms of the manufactured good). Note that the interest rate r_t is related to the rental rate R_t by arbitrage

$$\frac{1 - H_{2,t+1}}{\frac{1}{1+r_t} + H_{1,t}} = \frac{R_{t+1} + (1-\delta) - G_{2,t+1}}{1 + G_{1,t}} \tag{11}$$

Here $G_{k,t}$ represents the derivative of G with respect to its kth argument at date t, and $H_{k,t}$ has a similar interpretation. The left-hand side of the equation is the rate of return on the international bond where $\frac{1}{1+r_t} + H_{1,t}$ units of the manufacturing good are needed to purchase one unit of the bond, which returns $1 - H_{2,t+1}$ units of the manufacturing good in the next period. The right-hand side is the rate of return on investment where $1 + G_{1,t}$ units of the manufacturing good are needed to secure one unit of investment which returns $R_{t+1} + (1-\delta) - G_{2,t+1}$ units of the manufacturing good the next period. Note that when the regions are in autarky the $H_{k,t}$ terms all become zero and the left-hand side simplifies to $1 + r_t$.

We assume that the two regions begin in autarky and open to trade at some date T. Prior to T, there is no trade in manufactured goods and holdings of the international bond are equal to zero. We assume that T is unanticipated.

Given this market structure, the market clearing conditions are the usual ones. Since agriculture and services are non-traded,

$$C^i_{jt} = Y^i_{jt} \qquad j \in \{a, s\} \text{ and } i \in \{A, B\} \tag{12}$$

Market clearing for manufactured goods takes the form

$$C^i_{mt} + K^i_{t+1} - (1-\delta)K^i_t + G(K^i_{t+1}, K^i_t) = Y^i_{mt} \qquad i \in \{A, B\} \tag{13}$$

for $t < T$ and,

$$\sum_{i\in\{A,B\}} C^i_{mt} + K^i_{t+1} - (1-\delta)K^i_t + G(K^i_{t+1}, K^i_t) + H(D^i_{t+1}, D^i_t) = \sum_{i\in\{A,B\}} Y^i_{mt} \tag{14}$$

thereafter. Note that we assume that the adjustment costs are paid in terms of the manufactured good. For $t < T$, $D_t^i = 0$. Thereafter

$$D_t^A + D_t^B = 0$$

Finally factor markets clear

$$\sum_{j \in \{a,m,s\}} K_{jt}^i = K_t^i \qquad i \in \{A, B\} \tag{15}$$

$$\sum_{j \in \{a,m,s\}} L_{jt}^i = L^i \qquad i \in \{A, B\} \tag{16}$$

Note here that we allow the size of the labor force to differ between the two blocks. We use this to adjust the relative size of the two regional economies. This merely scales the economies when they are closed. It affects the relative impact of capital flows when they open to intertemporal trade.

An equilibrium is a sequence of prices $\{r_t^A, r_t^B, P_{at}^A, P_{mt}^A, P_{at}^B, P_{mt}^B, W_t^A, R_t^A, W_t^B, R_t^B\}$, consumptions $\{C_{at}^A, C_{mt}^A, C_{st}^A, C_{at}^B, C_{mt}^B, C_{st}^B\}$, capital allocations $\{K_{at}^A, K_{mt}^A, K_{st}^A, K_{at}^B, K_{mt}^B, K_{st}^B\}$, and labor allocations $\{L_{at}^A, L_{mt}^A, L_{st}^A, L_{at}^B, L_{mt}^B, L_{st}^B\}$ such that firms and consumers maximize given prices and markets clear.

2.2. Solution

The model as written is non-stationary, with growing output and unstable consumption shares. The model can be transformed into a stationary model through the appropriate transformation. Specifically, as the impact of the time-varying preferences dissipates, the economy converges to a generalized balanced growth path. Then, the capital allocated to each sector grows at rate λ, so that all variables measured in terms of the manufactured good grow at rate λ. Output and consumption of agricultural goods grow at rate $\lambda^\theta \mu$, and output and consumption of services grow at rate $\lambda^\phi \nu$. Along this balanced growth path prices of agricultural goods and services grow at rates $\lambda^{(\theta-1)}\mu$ and $\lambda^{(\phi-1)}\nu$ respectively. We use lower case letters to represent variables normalized by these growth rates. For example, $c^i_{at} = \frac{C^i_{at}}{\lambda^{\theta t}\mu^t}$, $c^i_{mt} = \frac{C^i_{mt}}{\lambda^t}$, and $c^i_{st} = \frac{C^i_{st}}{\lambda^{\phi t}\nu^t}$.[5] With this normalization the period utility functions become

$$U^i_t = \sum_{j\in\{a,m,s\}} \alpha_j \ln(c^i_{jt}) - \tilde{\epsilon}^i_{jt} c^i_{jt}. \tag{17}$$

Here $\tilde{\epsilon}^i_{at} = (\lambda^\theta\mu)^t \epsilon^i_{at}$ and $\tilde{\epsilon}^i_{mt}$ and $\tilde{\epsilon}^i_{st}$ are similarly related to ϵ^i_{mt} and ϵ^i_{st}. The budget constraint becomes

$$p^i_{at}c^i_{at}+c^i_{mt}+p^i_{st}c^i_{st}+k^i_{t+1}+\frac{\lambda d^i_{t+1}}{1+r_t} = w^i_t L^i_t - R^i_t k^i_t + (1-\delta)k^i_t - d^i_t - \frac{\psi_1}{2}\frac{(\lambda k^i_{t+1}-k^i_t)^2}{k^i_t} - \frac{\psi_2}{2}(\lambda d^i_{t+1}-d^i_t)^2 \tag{18}$$

The production functions and market clearing conditions also become stationary.

Note that the consumption shares of the transformed economy are the same as the consumption shares of the original economy. For example, the consumption share of agricultural goods is

$$\frac{p^i_{at}c^i_{at}}{p^i_{at}c^i_{at}+c^i_{mt}+p^i_{st}c^i_{st}} = \frac{\lambda^{(\theta-1)t}\mu^t P^i_{at}\frac{C^i_{at}}{\lambda^{\theta t}\mu^t}}{\lambda^{(\theta-1)t}\mu^t P^i_{jt}\frac{C^i_{at}}{\lambda^{\theta t}\mu^t} + \frac{C^i_{mt}}{\lambda^t} + \lambda^{(\phi-1)t}\nu^t P^i_{st}\frac{C^i_{st}}{\lambda^{\phi t}\nu^t}} = \frac{P^i_{at}C^i_{at}}{P^i_{at}C^i_{at}+C^i_{mt}+P^i_{st}C^i_{st}} \tag{19}$$

This implies that, when the transformed economy is in steady state, the consumption shares in the original economy are constant although prices and consumption continue to drift in opposite directions.

Our solution method consists of first solving the stationary version of the model and then recovering the results for the growing economy. In this sense, our solution is similar to Echevarria (1997). However, since we have an open economy, we require a shooting algorithm to find the long-run level of debt such that all of the restrictions in our model – including

[5]Other variables are defined similarly: $k^i_t = \frac{K^i_t}{\lambda^t}$, $k^i_{jt} = \frac{K^i_{jt}}{\lambda^t}$, $i^i_t = \frac{I_t}{\lambda^t} = \lambda k^i_{t+1} - (1-\delta)k^i_t$, $d^i_t = \frac{D^i_t}{\lambda^t}$, $w^i_t = \frac{W^i_t}{\lambda^t}$, $p^i_{at} = \lambda^{(\theta-1)t}\mu^t P^i_{at}$, $p^i_{st} = \lambda^{(\phi-1)t}\nu^t P^i_{st}$.

the transversality condition – are satisfied.

The algorithm proceeds as follows. We make a guess for the steady-state trade balance of Block A and solve the perfect foresight model using this guess and the initial conditions for debt and the capital stocks in each block. Using this solution, we verify that the transversality condition is satisfied. If it is satisfied, our guess satisfies all the constraints and we have found a solution. If the transversality condition is not satisfied, then we adjust our guess of the steady-state trade balance appropriately. For example, if Block A has too much saving in the recovered equilibrium, we decrease our guess for the final trade balance position of Block A.

3. Calibration

We take the following approach to calibrating the model. We first fit the closed economy model to Block A. We calibrate capital shares (θ, γ, φ), sectoral growth rates (μ, λ, μ), and depreciation (δ) to match the long run characteristics of the Block. We calibrate the efficiency parameters (A^A,B^A,C^A) to match the level of output and relative prices in 2017. We calibrate preferences (α_j, ϵ_j, ρ_j) to match sectoral shares at the beginning and end of the sample, and the adjustment costs (ψ_1) to match the initial ratio of investment to GDP.

We then take the model for Block A and adjust it to fit Block B. We make four adjustments. Since these adjustments interact, we perform them simultaneously. It is instructive, however, to think of them as occurring one at a time. The first adjustment is to add a few decades to the time subscript in Block A so that the resulting GDP in 1960 is equal to that of Block B. This has the effect of delaying development in Block B relative to Block A and will help match the fact that sectoral transformation and the hump in investment occur later in time in Block B. The second adjustment is to choose the efficiency parameters (A^B,B^B,C^B) to match the level of output and relative prices in Block B in 2017. The main effect is to reduce aggregate productivity in Block B relative to Block A at the same stage of development. This will help to match the fact that the hump in investment in Block B occurs at a lower level of productivity.[6] The third difference between the Blocks is that we choose the capital stock in Block B in 1960 to match the value in the data. Finally, we choose the relative population of Block B to roughly match the difference in population between the two Blocks over the sample.

This leaves the debt adjustment cost. We calibrate this to match the volume of inter-Block capital flows that we observe in the data.

There are several features of the data that will be determined endogenously by the model and will therefore be a measure of how well our model explains patterns of growth and sectoral change. We do not match the hump in investment in either block. We only match the initial level of investment in Block A. We do not attempt to match the paths of sectoral adjustment in Block B. We match only the level of GDP in 1960. We do not attempt to match the impact of capital flows between the Blocks. We match only the overall volume of these flows.

The remainder of this section explains the calibration in detail.

3.1. Long-run parameters

3.1.1. Production functions

We calibrate the production functions to final output. To calibrate the capital shares (θ, γ, φ), the growth rates of total factor productivity in agriculture and services (μ, ν), and labor augmenting total factor productivity in manufacturing λ, we use data from the Timmer et al. (2015) (WIOD) from 2000 to 2014 for countries in Block A in local currency units. In particular, we use data on sectoral wages, total hours, number of workers, and total output per sector and year in local currency units. We define our three sectors aggregating SIC sub-sectors as follows: agriculture in the model corresponds to agriculture and mining in SIC 01-14; manufacturing includes manufacturing and construction SIC 15-39; and services includes SIC 40-97. Our calibration of manufacturing excludes software and intellectual

[6] Since the efficiency parameters also affect Block B GDP in 1960, these first two steps must be taken at the same time.

property, which has become more important in recent years, specially in Block A.[7] The aggregation of services in the WIOD makes it hard to identify software and intellectual property as investment goods early in the sample.[8]

We define the capital share as one minus the labor share, averaged across countries and over time. Table C.2 in the online appendix shows the summary statistics by country in Block A. To aggregate, we first take the average per year over all countries in the block and then we average over all years. Table 2a shows the summary statistics for these parameters. According to the data, agriculture is the most capital-intensive sector and manufacturing is the least capital-intensive sector.

To calculate the growth rates of total factor productivity in agriculture and services (μ, ν), and the growth rate of labor augmenting TFP in manufacturing λ, we use data on output, capital, and labor in each sector of each country in Block A together with the estimated capital shares to calculate TFP for each sector of each country in years 2000 and 2014. We use these estimates of TFP to compute TFP growth rates by country and sector, and then average across countries in the Block.[9] Table C.3 in the online appendix shows the summary statistics per country in Block A between 2000-2014. We then define $\mu = \exp(g_{jA} - (1-\theta)n)$ as the growth rate in agriculture, $\nu = \exp(g_{jC} - (1-\varphi)n)$ as the growth rate in services, and $\lambda = \exp(\frac{g_M}{\gamma} - n)$ as the growth rate in manufacturing. Here n is average population growth rate in the US between 1960 and 2017, which is equal to $n = 0.98\%$. [10]

Table 2b summarizes these results, with the calibrated parameters corresponding to the first column. Productivity growth is highest in manufacturing and is roughly equal in agriculture and services.[11]

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[7] Note that we calibrate our model to final output rather than value added so that manufacturing includes intermediate inputs from all sectors.

[8] Also, the PWT 9.1 does not include software and intellectual property as they are deemed too hard to measure in a consistent manner across countries.

[9] We choose 2000 and 2014 because those are the years for which WIOD provides data on capital and employment across sectors.

[10] The model results are not qualitatively sensitive to the population growth rate or the aggregation method.

[11] Recall, that λ is labor augmenting, while μ and ν are not. TFP growth in manufacturing is roughly $1.0212^{0.64} = 1.0135$.

Note that factor intensity differs across sectors, but productivity growth is very similar across sectors. Hence factor intensity will play a larger role in generating structural transformation in our model (Acemoglu and Guerrieri (2008)), than will differences in productivity growth (Ngai and Pissarides (2007)).

3.1.2. Depreciation and Discount Factor

To calibrate the depreciation rate, δ, we use the annual depreciation rate from PWT 9.1 for 1960 to 2017. Following the same pattern of aggregation, we first average the depreciation rate per year over all countries in Block A, and then we average over all years. Table 2c summarizes these results.

To calibrate the discount factor, β, we set the steady-state interest rate equal to 4.8%. This rate corresponds to the average 1-year Treasury constant maturity rate between 1953 to 2017.[12] We use the debt Euler equation to derive β. This condition implies a discount factor $\beta = 0.9671$.[13]

3.2. Preferences and Adjustment Costs

We calibrate the utility parameters ($\alpha_j, \epsilon_j^A, \rho_j$ for $j = \{a, m, s\}$) and the investment adjustment costs (ψ_1) to match the sectoral output shares in 1991, 1960 and 1930 in the data for Block A, as well as the investment share in 1960. To calibrate α_j we use sectorial output shares from WDI[14] for 1991, and investment share from PWT 9.1. Recall that the time-varying term declines and preferences converge to Cobb-Douglas preferences. We assume that Block A was in steady-state in 1991 before the market integration. Since in our

[12] 1-Year Treasury Constant Maturity Minu Federal Funds Rate [T1YFF], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/T1YFF,(09/12/2022)

[13] In steady-state, the debt Euler equation is:

$$\lambda \left[\frac{1}{1+r} - \psi_2(\lambda - 1) \right] = \beta \left[1 - \psi_2(\lambda - 1)\lambda \right]$$

[14] Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Manufacturing corresponds to ISIC divisions 10-45, including mining, and services correspond to ISIC divisions 50-99.

model production of manufacturing includes investment and capital adjustment costs, the relationship between the production shares in the data and the steady-state consumption in the model is defined as follows:

$$\alpha_a = \frac{Y_a}{1 - IY} = 0.0544 \tag{20}$$

$$\alpha_m = \frac{Y_m - IY}{1 - IY} = 0.0677 \tag{21}$$

$$\alpha_s = \frac{Y_s}{1 - IY} = 0.8779 \tag{22}$$

where Y_j for $j = \{a, m, s\}$ are the production shares in the data, and IY is the investment share in the data. Note the large service sector share reflects the importance of services near the end of the sample.

To calibrate ϵ^A_{j0}, ρ_j, and ψ_1 we use an iterative process to match the model with the data production shares in 1930 and 1960 and the investment share in 1960. We first guess values for ϵ^A_{j0}, ρ_j, and ψ and solve for the closed economy model between 1930 to 1960 for Block A. Then, we compute the difference between the model and the data consumption shares in 1930 and 1960. ϵ_j governs the curvature and allows us to match the initial year, while ρ_j governs the persistence and allows us to match 1960's shares. ψ_1 governs the initial level of the investment share. We iterate the model over a grid of values until the rates match by first increasing ϵ_a and ϵ_m and then adjusting ϵ_s. Once we fix the initial point, we adjust the persistence level until we match 1960's values. Finally, we adjust ψ_1 to match the investment share in 1960. Figure C.3 in the appendix shows the simulated path of the time-varying term per sector and block.

Using the same iterative process, we calibrate the portfolio adjustment cost parameter (ψ_2) to match the area under the capital inflows to Block B between 1991 and 2017.

3.3. Differences between Blocks

Finally, we calibrate the parameters that differ between Blocks A and B. First, we initialize the development process. This involves both the parameter $\bar{t}_i$ and the initial capital stocks. According to our model, all economies are following the same development process, and differences in GDP can be interpreted as the economies being at different points on this path. In this sense, we solve for an arbitrary closed economy with an initial capital stock close to zero[15], and define that each Block is in the period that minimizes the distance between the real GDP per capita in 1960 and the GDP implied by this path. We find that Block A in 1960 was on its 40th year of the development path, while Block B was in the 20th year of the development path and use the implied level by $\bar{t}_A = 1920$ and $\bar{t}_B = 1940$ as the initial capital stock.

Second, we calibrate the efficiency parameters $\{A^i, B^i, C^i\}$ to match the output levels on each block in 2017. To do so, we use the parameters of the model, data on GDP per capita in 2017, and data on relative prices of consumption in 2017 on each block to solve for the steady-state of the stationary closed economy. We use data from the ICP in 2017 on sectoral relative prices and real GDP per capita in PPP for Block A from PWT 9.1. We compute relative prices in agriculture and services as the deflator per sector, that is nominal expenditure to real expenditure, to the corresponding price in manufacturing. Following Echevarria (1997) we classify expenditure into three sectors. First, agriculture (Cat. 03-04) includes food and non-alcoholic beverages, alcoholic beverages, tobacco, non-alcoholic beverages, and alcoholic beverages, tobacco and narcotics; manufacturing (Cat 05-07) includes clothing and footwear, actual housing, water, electricity, gas and other fuels, furnishings, household equipment and routine household maintenance, purchase of vehicles, net purchases abroad, and collective consumption expenditure by government; finally, services (Cat. 08-14) include health, transport, communication, recreation and culture, education, restaurants and hotels,

[15]The minimum possible capital stock to obtain a solution for the model corresponds to $10 US in PPP 2011.

miscellaneous goods and services, and transport. Table 4 shows relative prices and GDP per capita in year 2017. P_1, P_2, and P_3 correspond to the deflator in the data, while p_1 and p_3 are the relative prices.

Finally, we calibrate ϵ_{j0}^B to capture the difference in the structural transformation process. We set ϵ_{j1960}^B as the one Block A had in 1930 as follows:

$$\epsilon^A_{1930-\bar{t}_{A,j}} = \epsilon^B_{1960-\bar{t}_{A,j}} \tag{23}$$

Recall that $\bar{t}_{A,j} = 1920$ and $\bar{t}_{B,j} = 1940$. Table 5 presents all the parameters in the calibrated model.

4. Comparing the Model to the Data

Given the calibrated parameters, we simulate the model assuming financial markets open in 1991. Prior to 1991, both regions are effectively closed. After 1991, they engage in intertemporal trade. The opening of financial markets is unanticipated. We start by comparing the simulated paths for the investment rate as a function of real per capita income in the data and in the model (Figure 8). The dots in the figure are data and correspond to the dots in Figure 3. The solid line in the figure shows the path of investment for each block under the assumption that both blocks remain closed through the full sample. The light dotted line shows the perturbation to investment in both regions when the economies open to capital flows.

There are several points to emphasize in the figure. First, the investment rates produced by the model exhibit the hump shape in the data. This is fact 1. Second, the investment rate peaks at a lower level of per capita income in Block A than in Block B. This is fact 2. The final observation is that when capital market liberalization occurs, the investment rate drops in Block A and increases in Block B. The increase in B is larger because it is expressed as a share of GDP, which is lower in Block B. In both cases, the open-economy path fits the data somewhat better than the closed-economy path. The improvement in fit is even more evident in Figure 9 where the two investment curves are plotted together. Block B peaks at a lower level of per capita income, and openness accelerates the increase in investment. The model misses most badly in matching the large decline in investment in Block A near the end of the sample.[16]

Recall that the only aspect of Figure 3 that the model is calibrated to match is the level of I/K in Block A at the beginning of the sample.[17] In addition, the model abstracts from all financial crises, including the debt crises of the 1980's, the Asian Crisis and the Great Recession in 2008. In spite of all this, the model fits the evolution of investment in Block B remarkably well.

The model sheds light on the economic mechanisms underlying the hump-shaped path in investment. Theory provides several potential explanations for this path, including differential sectoral growth rates, differential labor shares, and non-homothetic preferences. To understand what features of the model determine the hump-shape in investment, Figures 10a and 10b compare the simulated paths of the investment share between the model and data using different specifications. Panel (a) shows the baseline model. Panel (b) eliminates differences across sectoral growth rates by setting all the sectoral rates to 1.01. Panel (c) eliminates differences in the labor shares across sectors and regions by setting all labor shares equal to the baseline value of the manufacturing sectors, 0.38. Panel (d) eliminates differences in the efficiency parameters across sectors, but keeps the difference between regions. We set the efficiency parameters equal to the baseline efficiency parameter in manufacturing per block, 0.48 and 0.24 correspondingly. Panel (e) eliminates the time-varying term by setting $\tilde{\epsilon}^i_{j,0}$ and ρ_j to be equal to zero. The features that are most important in matching

[16]Recall that our measure of investment excludes software and intellectual property. We hypothesize that if these were included then the data might match the model more closely because the model misses innovations in technology that stimulated investment in the post-1990 period.

[17]One potential concern with our calibration strategy is that Block B's structural parameters could be potentially very different from those of Block A. Tables 3a, 3b, and 3c show the growth rates, capital shares, and depreciation rate for Block B. We highlight that the structural parameters between Blocks are remarkably similar. In addition, in exercises not shown in the paper, we repeated the simulation using different parameters for each Block and the main results of the paper remain.

the shape of investment hump are the differential sectoral growth rates and the differential factor shares. Time-varying preferences and levels of sectoral productivity play little role in matching the path of investment.

Note that none of the experiments in Figures 10a and 10b affect the timing of the hump in investment. The parameters that affect the timing of investment in the model are A^i, B^i, and C^i. If we set these parameters equal in both Blocks, then the humps in investment would occur at the same level of GDP, thereby eliminating the leftward shift in Block B's investment curve relative to Block A.

The model also produces time paths for production by sector that can be compared to data. Figure 11 provides this comparison for both Blocks A and B. The model (dotted lines) generates paths that are roughly consistent with the data - the general decline in agriculture and the increase in services - though the fit is better for Block A than for Block B. Recall that the model is calibrated to match Block A as closely as possible. Only the date at which development begins is chosen to match Block B. Our third fact states that structural transformation and investment in Block B from 1960 to 2010 is comparable to Block A from 1930 to 1980. Figure 12 repeats this exercise with the simulated data. The sectoral shares from the shaded areas of Figure 12 are remarkably similar. In general, the key factors that explain the path of structural transformation in the model are the time-varying preferences and the efficiency parameters. See Figures D.6a and D.6b in the online appendix.

Our fourth fact is that there was a surge in capital flows beginning around 1991. Figure 13 shows private capital flows from Block A to Block B in the model and the data. The initial date of liberalization is assumed to be 1991. The volume of capital flows shown in the figure is endogenously generated by the model. The surge in capital flows peaks at around 4 percent of Block B GDP, higher than in the data. However, it drops off quickly.

The surge in capital flows causes both investment and consumption to rise in Block B and fall in Block A. Figure 14 plots each investment curve (model and data) relative to time. The vertical line shows the date of capital market liberalization. At that point, the two investment paths diverge, causing the investment rate to rise in Block B and fall in Block A. The investment rate in Block A then flattens relative to the closed-economy path. Because Block B has borrowed from Block A and must pay interest in terms of the traded manufacturing good, B's investment rate is slightly above where it would have been as a closed economy, and in A's is slightly lower in the very long run. (See Figure D.4 in the online appendix.)

The rise in investment in Block B raises output and consumption. Figure 15 shows the impact of capital market liberalization on consumption of each of the three goods in Block A and Block B. The figure plots the time path of consumption relative to the path consumption would have followed if the economy had remain closed. Block B consumption rises on impact. Consumption of agriculture increases the most, while services increase the least. The rise in investment increases the supply of capital and drives down the price of capital-intensive goods such as agriculture. In the long run, Block B must pay for the capital it borrows in the short run and consumption falls below the level it would have had if the economy had remained closed. Note that this is where the difference between time-varying tastes and non-homothetic preferences might matter. If preferences depended on the level of consumption, then the rise in consumption in Block B accompanying capital market liberalization would push Block B further along the development path (income effect). This would increase the consumption of services and manufacturing relative to agriculture bringing the three curves in Panel (B) of Figure 15 closer together. Following similar logic, the decline in consumption in Block A will pull the three curves further apart. In an earlier version of the model with non-homothetic preferences, this effect was small and was dominated by the decline in the price of capital-intensive agriculture.

The response of consumption in Block A is the mirror image of the response of Block B. In the short run, consumption falls in Block A as the Block attempts to take advantage of profitable investment opportunities in Block B. In the long run Block A is able use its accumulated wealth to consume more than it would have had the economy remained closed.

We see the effects of financial liberalization on sectoral production in Figure 16. This figure plots the time path of production relative to the path production would have followed had each block remained closed. In Block A, the desire to export capital causes production to initially shift towards manufacturing. This shift comes at the expense of agriculture and services. In the long run, manufacturing production declines relative to the closed economy benchmark, as Block B exports capital to pay off its debt. The response of Block B is the mirror image.

Finally, we compare the model's fit to features of the data beyond the four empirical facts we identified in Section 1. In particular, Figures 17a and 17b compare the simulated paths of output per worker, the capital-output ratio, and relative prices with their counterparts in the data for Blocks A and B. The model does remarkably well in tracking output per worker in both Blocks. Recall that we calibrate the model to match initial and final GDP in both Blocks, but the evolution of capital is endogenous. The model also captures the trend in the capital-output ratio over the long-run, though the paths diverge in the middle decades. The model does not do a good job of reproducing the relative prices of agricultural goods and services in levels (both prices defined relative to manufacturing). According to the model, agricultural goods and services are too cheap relative to manufactured goods than what we see in the data. Despite being off in levels, both relative price series trend upward in the two regions, consistent with their empirical trends.

5. Welfare

In this section we use our model to evaluate the welfare effects of capital market liberalization. Who gains from liberalization? How does the timing of reform affect these gains? Not surprisingly, we find that the welfare gains are larger if the two economies integrate earlier. We find that Block B gains more than Block A, and that Block B's gains are more sensitive to the timing of liberalization.

Evaluating the welfare effects of a policy change in a multi-good setting is not as straightforward as it is in a single-good economy. There is no natural numeraire good in a multi-good setting. Microeconomic theory has focused on two different measures of the welfare impact of a change in policy. These two measures agree on the sign of the welfare change, but, since they use different prices, they can differ in magnitude. The first is the *compensating variation*. The compensating variation takes as its starting point the post-reform equilibrium and the post-reform prices. It asks, "How much and in what direction must the present value of income change in order for agents to experience the pre-reform present-value utility at these post-reform prices?" In this sense, it reflects the compensation that would make agents living in the post-reform world indifferent to the reform (ignoring the general equilibrium feedback that actual compensation would naturally bring on). The *equivalent variation*, on the other hand, begins with the pre-reform equilibrium and the pre-reform prices, and asks "How much and in what direction must the present value of income change in order for agents to experience the post-reform present-value utility at the pre-reform prices?" The equivalent variation measures the wealth change that is equivalent to the policy reform from the pre-reform perspective.

Let $E_t(V_t, P_t)$ denote the expenditure in date t necessary to reach present value utility $V_t = \sum_t^{\infty} \beta^t U_t$ given a price vector P_t. Note that P_t is a vector of the date-t prices of all goods in all periods $s \geq t$. We can write the compensating variation of a reform at date t as,

$$CV_t = E_t(V_t^{open}, P_t^{open}) - E_t(V_t^{closed}, P_t^{open}) \tag{24}$$

Here V_t^{open} is the present value of utility if capital markets are opened in period t and V_t^{closed} is the present value of utility of capital markets remain closed forever. P_t^{open} is the price vector if capital markets are open. As noted above, the compensating variation uses post-reform prices to transform the change in utility into a change in expenditure. If $CV_t > 0$, the reform raises welfare. Similarly we can write the equivalent variation of a reform at date t as,

$$EV_t = E_t(V_t^{open}, P_t^{closed}) - E_t(V_t^{closed}, P_t^{closed}) \tag{25}$$

where the only change is that the equivalent variation uses P_t^{closed}, the price vector in the case that capital markets remain closed, to transform the change in utility in to a change in expenditure. Given that expenditure E_t is monotonically increasing in utility V_t, the compensating variation CV_t and equivalent variation EV_t are either both positive or both negative.

Using our model to calculate these quantities, we find liberalization in 1991 was welfare improving for both blocks, but that Block B gained more from liberalization than Block A.[18] The compensating variation to liberalization in 1991 is 0.01% of GDP for Block A and 0.286% of GDP for Block B. The equivalent variations are 0.005% for Block A and 0.41% for Block B. The per capita gains implied by the compensating variation in terms of 2017 US dollars are $8.96 in Block A and $85.4 in Block B.

There are two reasons that the gains from liberalization are small. The first is that capital market integration does not affect growth rates but simply reallocates capital in the short term from one region to another. The second reason is that the economies had largely converged to their balanced growth paths according to the model. The gains would be larger if the economies had opened sooner. Figure 18 graphs the compensating variation as a function of the date of liberalization. One complication is that CV_t is calculated in terms of the numeraire at date t. In order to make all of the quantities comparable, we used the closed economy interest rate to transform all expenditure into 2017 dollars. Here we find that the gains to Block A are relatively insensitive to the date of liberalization, whereas Block B has a clear preference for liberalizing earlier.

6. China's Integration

Our two-country model includes the North and the South but excludes China, which is becoming an increasing force in world markets. It is natural to ask how the investment

[18] Interestingly, which region gains is somewhat sensitive to how we allocate countries to Blocks A and B. For example, if Greece, Ireland, Portugal and Spain are assigned to Block A, then Block A gains slightly more from liberalization than does Block B.

patterns would change if we were to include China in the model. To date, China remains largely closed to private capital flows. It is very difficult for foreigners to invest in China and own Chinese companies. The question then becomes, "What would happen if China liberalized its capital markets?"

To answer this question, we consider a simple experiment. Rather than solve a three country model with three sectors, we model China as a new exogenous investment opportunity. In our experiment, we assume that China liberalizes to asset trade with Blocks A and B in 2017 (which is the end of our sample). We assume that both Blocks A and B can trade with China at an exogenous interest rate that mimics the path of the world interest rate after the integration of Blocks A and B. Otherwise the calibration of the model is the same. In effect, Blocks A and B are modeled as small open economies, facing an exogenously higher Chinese interest rate. This experiment should give a qualitative indication of the impact of Chinese liberalization.

Table 6 shows the welfare impact of Chinese liberalization in this scenario. Block A gains after the integration, but Block B loses. To get some idea of why Block A gains more than Block B. Figures 19a and 19b illustrate the path of capital flows for the two integration dates. We see that capital flows from Block A to Block B when these two regions integrate in 1991, but capital flows from both blocks towards China when China integrates. Figure 20a shows that saving rises in both blocks and investment falls.

The picture that emerges is that China's liberalization presents the world with a new investment opportunity and raises the world interest rate and the marginal product of capital. This raises income in both blocks and causes capital to shift toward China. There is an additional effect of integration, however. Block A is a creditor at the time of liberalization, whereas Block B is a debtor. The rise in interest rates therefore further raises the wealth of Block A, whereas it represents a capital loss in Block B.

The opening of China has interesting implications for the allocation of consumption and production across sectors as shown in figures 21a and 21b. The increased investment opportunities lead to a surge in manufacturing production in both Blocks A and B. Consumption in both regions falls in the short run and increases in the long-run. In Block A, the long run increase in consumption more than compensates for the short run decline. In Block B, however, the reverse is true.[19]

In our model China represents untapped investment opportunities available to global investors. Our analysis emphasizes the differential impact that these opportunities have on countries depending upon whether they are net borrowers or net lenders. Our model of China is thus very abstract and misses other aspects of China's role in the global economy, including its large footprint in manufacturing trade, and the impact of China's savings rate on the level of the world interest rate. These aspects are beyond the scope of our model.

7. Conclusions

In this paper, we develop a two-region model of the world economy that successfully mimics the dynamics of investment and sectoral change in advanced economies as well as emerging markets. The investment rate exhibits a "hump shape," increasing at early stages of economic growth and then declining at later stages. This is true of investment in both advanced and emerging economies, with the key difference being the date and income level at which the investment rate peaks. We also observe increasing shares of services in GDP and declining shares of agricultural goods in GDP, though again the timing of these changes depends on the stage of economic development. Finally we observe capital flows to emerging markets in the early 1990s that coincide with an increase in the investment rate in those economies.

We calibrate our model to macroeconomic data. The key differences between the two regions are that emerging markets start their path of economic development at a later point in time, with a lower capital stock and a less productive labor force. All other parameters

[19]The symmetry in the response of consumption across sectors indicates that the utility is essentially Cobb-Douglas at this point in time. This implies that modeling preferences as time-variant rather than non-homothetic has very little effect on the response of consumption and production.

governing economic growth, sector-specific production and utility functions are identical across the two regions. The model fits the data quite well, matching the timing and peak of the investment humps, the paths of sectoral change as well as the magnitude of capital flows at the time of capital market liberalization.

We then use our model to examine two counterfactuals. The first is an analysis of the welfare gains to the two regions if capital liberalization were to occur at different points in time. Because we have a multi-good model, we examine compensating and equivalent variation measures of welfare that take into account dynamic changes in relative prices. We find that both regions prefer to liberalize earlier than later – the difference in autarky interest rates diminishes over time as emerging markets catch up to advanced economies, and therefore the mutual gains from trade fall over time. Interestingly, we find that the developing economies capture the lion's share of welfare gains, though the differential between welfare gains to the two regions falls with time.

The second experiment is to consider the impact of China's integration into global financial markets. We model this as creating a new opportunity for both advanced and emerging markets to earn a higher rate of return on capital investment in China. Again, both regions gain, but China's opening redistributes capital away from emerging markets toward China. Because advanced economies are already a net creditor in global financial markets, the increase in the global interest rate generates a positive wealth effect and an increase in demand for non-traded goods and services.

Our analysis sheds light on the implications of capital market integration. Our model suggests that the policies of capital market liberalization of the 1990s redistributed capital across countries and altered the composition of output and consumption within countries, leaving the underlying rates of economic growth unchanged. The model also implies that future waves of liberalization may provide opportunities to earn higher rates of return, but may also increase the cost of finance for those countries carrying forward a legacy of debt.

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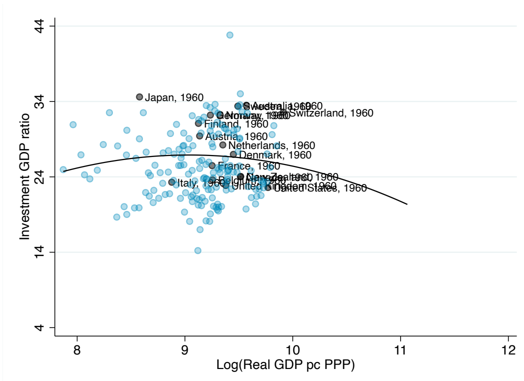
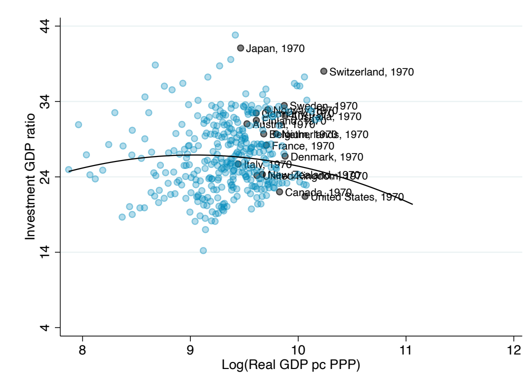
Tables and Figures

Figure 1: Evolution of the investment rate in Block A

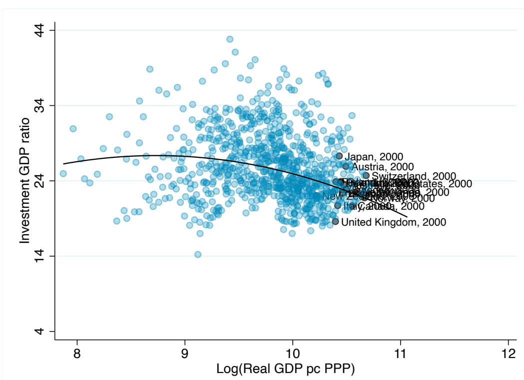
(a) 1950-1960



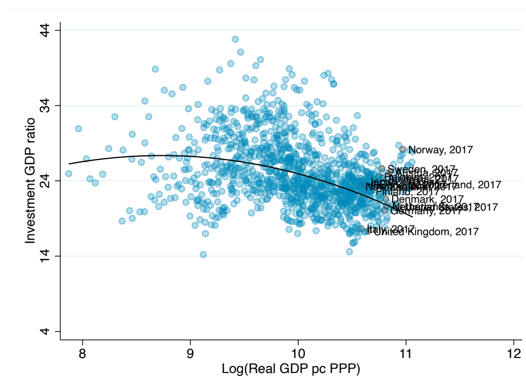
(b) 1950-1980



(c) 1950-2000

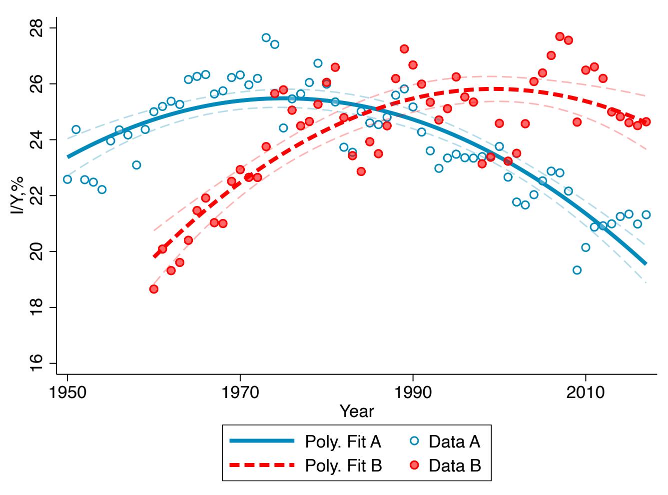


(d) All sample



Note: Each dot corresponds to a country in Block A in year t. Data Source: PWT9.1. The solid lines corresponds to the fitted value of: $\frac{I_{iAt}}{Y_{iAt}} = \beta_0 + \beta_1 \log(GDP_{iAt}) + \beta_2 \log(GDP_{iAt})^2 + \epsilon_{iAt}$

Figure 2: Investment rate for each region against time



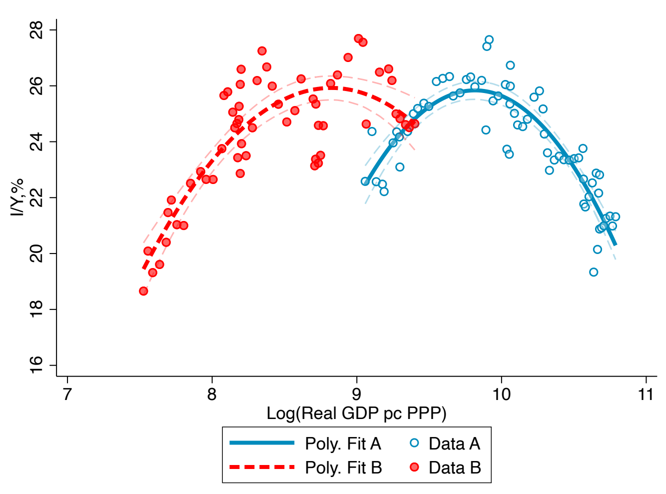
Note: Each dot corresponds to an observation in Block j in year t. We compute the investment ratio as total investment over total GDP in all countries in Block j, and GDP per capita as total GDP over total population in Block j. We use data from 1950-2017 for Block A and from 1960-2017 for Block B. Data Source: PWT9.1. Doted lines correspond 95% robust confidence intervals: $\frac{I_t}{Y_t} = \beta_0 + \beta_1 Year + \beta_2 Year^2 + \epsilon_t$

Table 1: Summary Statistics: Fitted parabola for each region

	$\max \hat{I/Y}\%$	*Real GDP*	$Year$
Block A	25.5	19,773	1975
	(0.2)		
Block B	25.9	6,056	1998
	(0.2)		

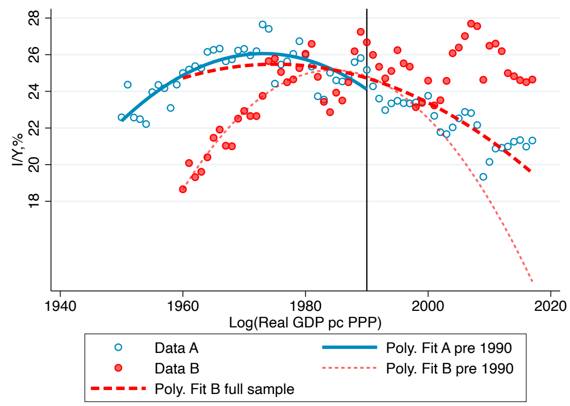
Note: Column 1 shows the maximum investment ratio of the fitted values of the following regression: $I_{jt}/Yjt = \beta_0 + \beta_1 Year + \beta_2 Year^2 + \epsilon_{jt}$. SUR standard errors in parenthesis. Column 2 shows the GDP per capita in the year of the peak fitted investment. Colum 3 shows the year of the peak fitted investment. Data Source: PWT9.1.

Figure 3: Investment rate for each region against per capita (PPP adjusted) income



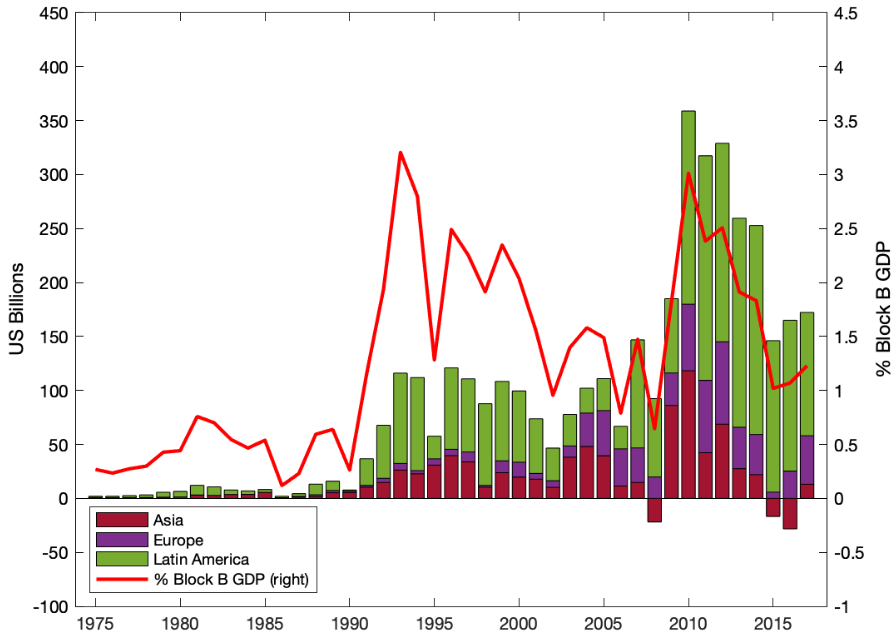
Note: Each dot corresponds to an observation in Block j in year t. We compute the investment ratio as total investment over total GDP in all countries in Block j, and GDP per capita as total GDP over total population in Block j. We use data from 1950-2017 for Block A and from 1960-2017 for Block B. We exclude years of sudden-stop recessions using the methodology in Calvo et al. (2006) (1975, 1982 and 2009 for Block A, and 1983, 1998, and 2001 for Block B). Data Source: PWT9.1. Dotted lines correspond to 95% robust confidence intervals: $I_{jt}/Yjt = \beta_0 + \beta_1 \log(GDP_{jt}) + \beta_2 \log(GD_{jt})^2 + \epsilon_{jt}$

Figure 4: Investment rate for each region against time using different polynomial fits



Note: Each dot corresponds to an observation in Block j in year t. We compute the investment ratio as total investment over total GDP in all countries in Block j, and GDP per capita as total GDP over total population in Block j. We use data from 1950-2017 for Block A and from 1960-2017 for Block B. Data Source: PWT9.1. The solid blue line corresponds to the fitted values of the regression $\frac{I_{At}}{Y_{At}} = \beta_0 + \beta_1 Year + \beta_2 Year^2 + \epsilon_{At}$. The dashed red line corresponds to the fitted values of the regression $\frac{I_{Bt}}{Y_{Bt}} = \beta_0 + \beta_1 Year + \beta_2 Year^2 + \epsilon_{Bt}$. The solid red line corresponds to the fitted values of the regression in A adjusted to match Block B's values in 1960.

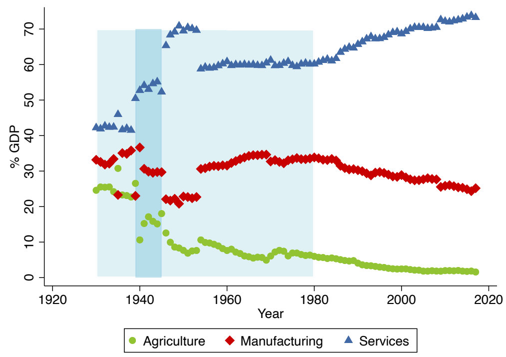
Figure 5: Private Capital inflows over GDP and flows of direct and portfolio investment into Block B



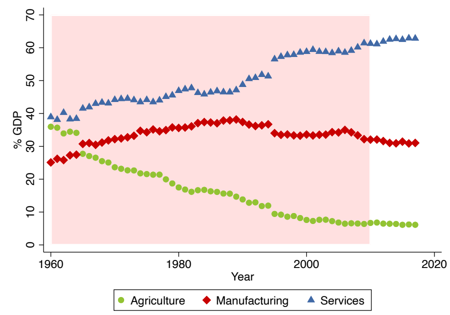
Note: Data Source: WDI. Direct + Portfolio investment inflow is defined as net incurrence of direct investment and portfolio investment liabilities. Asia: India, Indonesia, South Korea, Malaysia, Taiwan, and Thailand. Europe: Greece, Ireland, Poland, Spain, Portugal and Turkey. Latin America and the Caribbean: Argentina, Brazil, Chile, Mexico.

Figure 6: Shares of agriculture, manufacturing and services in GDP

(a) Block A

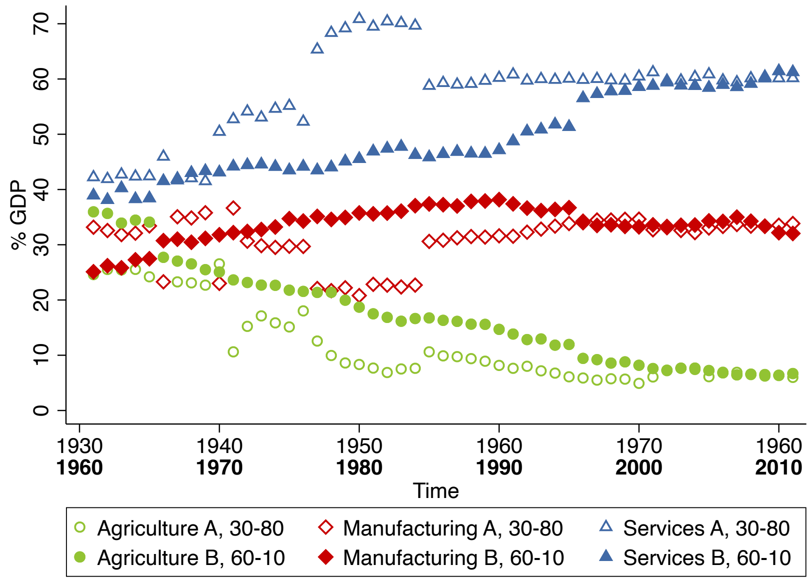


(b) Block B



Note: Data Source: WDI for the period 1960-2017, and Maddison Project Historical National Accounts for the period 1930-1960 for Block A. Agriculture includes ISIC 1-5, Manufacturing includes ISIC 10-45, and Services includes ISIC 50-99, excluding mining and wholesale trade. We normalize the data such that the shares add to one.

Figure 7: Comparing blocks: Sectoral Shares Block A 1930-1980 and Block B 1960-2010



Note: Data Source: WDI. Agriculture includes ISIC 1-5, Manufacturing includes ISIC 10-45, and Services includes ISIC 50-99, excluding mining and wholesale trade. Data for Block A corresponds to years 1930-1960, and data for Block B corresponds to years 1960-2010

Table 2: Summary Statistics of the long-run parameters: Block A

(a) Capital Shares

		Mean	**Std. Dev**	**Min**	**Max**
Agriculture	θ	0.40	0.27	0.06	0.82
Manufacturing	γ	0.49	0.12	0.28	0.64
Services	φ	0.48	0.11	0.32	0.69

(b) Total Factor Productivity Growth

		Mean	**Std. Dev**	**Min**	**Max**
Agriculture	μ	1.00	0.05	0.93	1.10
Manufacturing	λ	1.02	0.03	0.9625	1.07
Services	ν	1.01	0.02	0.96	1.02

(c) Summary Statistics: Depreciation Rate

		Mean	**Std. Dev**	**Min**	**Max**
Depreciation (%)	δ	3.7	0.2	3.5	4.2

Note: This table shows the summary statistics of the data we use to calibrate the long-run parameters in the model. We calibrate these parameters using data from Block A. We use the mean value as our parameters choice. Panel (a) summarizes the capital shares, panel (b) summarizes factor productivity growth, and panel (c) summarizes the depreciation rate. Panels (a) and (b) use data from the WIOD from 2000-2014. We classify sectors as follows: Agriculture and Mining SIC 01-14; Manufacturing and Construction SIC 15-39; Services SIC 40-97. Panel (c) uses data from Penn World Table 9.1. The table shows summary statistics for the depreciation rate of Block A between 1960-2017.

Table 3: Summary Statistics of the long-run parameters: Block B

(a) Capital Shares

		Mean	**Std. Dev**	**Min**	**Max**
Agriculture	θ	0.40	0.27	0.06	0.82
Manufacturing	γ	0.49	0.12	0.28	0.64
Services	φ	0.48	0.11	0.32	0.69

(b) Total Factor Productivity Growth

		Mean	**Std. Dev**	**Min**	**Max**
Agriculture	μ	1.0062	0.0537	0.9108	1.0832
Manufacturing	λ	1.0168	0.0619	0.9199	1.1034
Services	ν	1.0150	0.0327	0.9712	1.0701

(c) Depreciation

		Mean	**Std. Dev**	**Min**	**Max**
Depreciation (%)	δ	4.1	0.3	3.8	4.9

Note: This table shows the summary statistics of the long-run parameters of Block B. We use this data as robustness to our model. We use the mean value as our parameters choice when computing the additional model specifications. Panel (a) summarizes the capital shares, panel (b) summarizes factor productivity growth, and panel (c) summarizes the depreciation rate. Panels (a) and (b) use data from the WIOD from 2000-2014. We classify sectors as follows: Agriculture and Mining SIC 01-14; Manufacturing and Construction SIC 15-39; Services SIC 40-97. Panel (c) uses data from Penn World Table 9.1. The table shows summary statistics for the depreciation rate of Block A between 1960-2017.

Table 4: GDP per capita and Relative Prices in 2017

	GDP	P_1	P_2	P_3	p_1	p_3
Block A	48,464	0.890	0.953	1.055	0.933	1.107
Block B	12,094	0.653	1.053	1.107	0.619	1.051

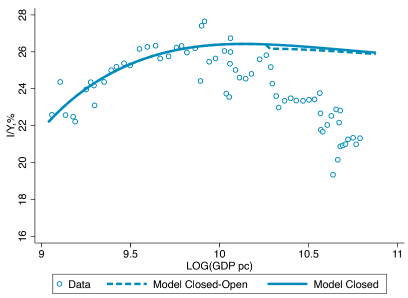
Note: GDP per capita in year 2017. P_1, P_2, and P_3 correspond to the deflator in the data, while p_1 and p_3 are the relative prices to manufacturing. Agriculture (Cat. 03-04) includes food and non-alcoholic beverages, alcoholic beverages, tobacco, non-alcoholic beverages, and alcoholic beverages, tobacco and narcotics; Manufacturing (Cat 05-07) includes clothing and footwear, actual housing, water, electricity, gas and other fuels, furnishings, household equipment and routine household maintenance, purchase of vehicles, net purchases abroad, and collective consumption expenditure by government; Services (Cat. 08-14) include health, transport, communication, recreation and culture, education, restaurants and hotels, miscellaneous goods and services, and transport.

Table 5: Parameters

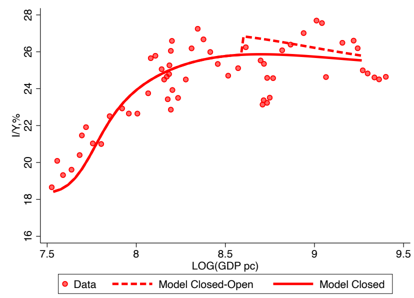
Preferences								
$\alpha_1 = 0.05$	$\alpha_2 = 0.07$	$\alpha_3 = 0.88$	$\tilde{\epsilon}^A_{1,0} = 18$	$\tilde{\epsilon}^A_{2,0} = 19$	$\tilde{\epsilon}^A_{3,0} = -0.8$	$\rho_1 = 0.91$	$\rho_2 = 0.89$	$\rho_3 = 0.99$
Production								
$A^A = 0.79$	$B^A = 0.47$	$C^A = 0.88$	$A^B = 0.64$	$B^B = 0.22$	$C^B = 0.42$	$\mu = 1.0028$	$\lambda = 1.02$	$\nu = 1.0049$
$\theta = 0.54$	$\gamma = 0.36$	$\phi = 0.39$						
Other								
$\beta = 0.97$	$\delta = 0.04$	$t_{1,A} = 1920$	$t_{1,B} = 1937$	$\Psi = 5.1$	$\Psi_2 = 8.16$			

Figure 8: The simulated paths of the investment rate relative to real per capita GDP for both Blocks A and B

(a) Block A

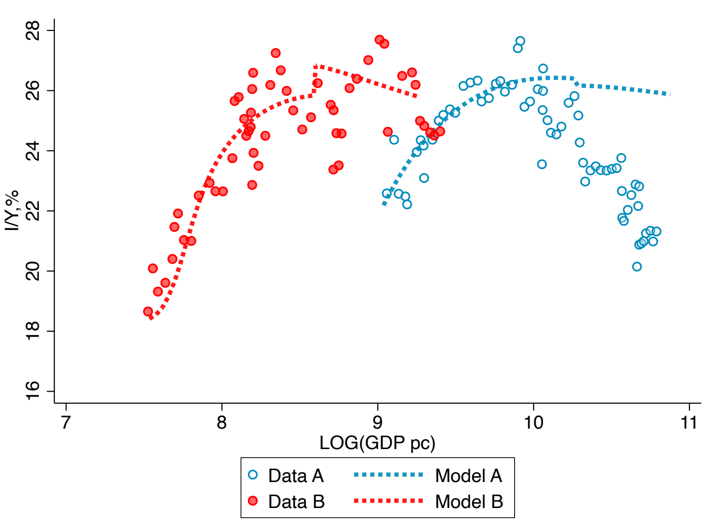


(b) Block B



Note: Each dot corresponds to an observation in Block j in year t. Data Source: PWT9.1. The solid line corresponds to the simulated results of the closed economy, and the dashed line corresponds to the open economy opening in 1991.

Figure 9: The simulated paths of the investment rate relative to real per capita GDP for both Blocks A and B



Note: Each dot corresponds to an observation in Block j in year t. Data Source: PWT9.1. The dashed line corresponds to the simulated results of the model opening in 1991.

Figure 10a: Determinants of the hump shape: Block A

(a) Baseline **(b)** Growth rates **(c)** Labor shares **(d)** Efficiency **(e)** Preferences

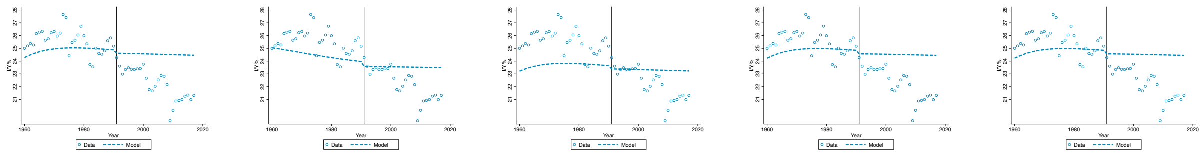
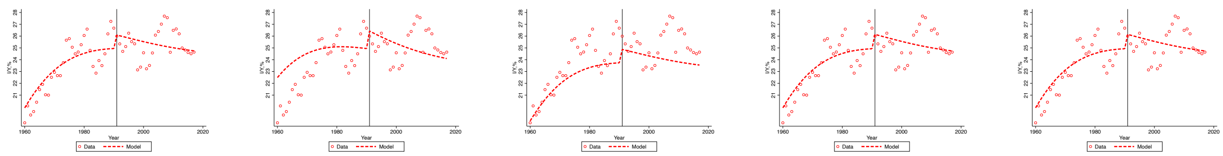


Figure 10b: Determinants of the hump shape: Block B

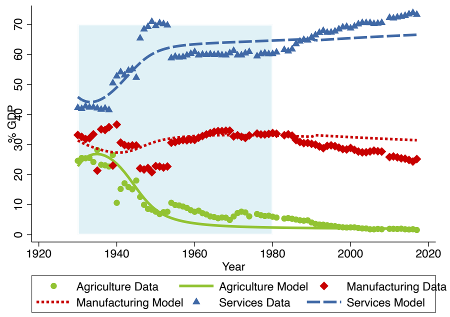
(a) Baseline **(b)** Growth rates **(c)** Labor shares **(d)** Efficiency **(e)** Preferences



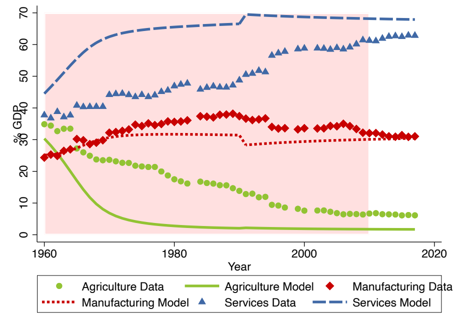
Note: Panel (a) compares the simulated path of the investment share to GDP versus the baseline model. Panel (b) uses the same growth rate across sectors and regions. We set $\lambda = \mu = \nu = 1.01$. Panel (c) uses the same labor share across sectors and regions $\theta = \gamma = \varphi = 0.38$. Panel (d) uses the same efficiency parameters across sectors by region: $A^A = B^A = C^A = 0.48$, and $A^B = B^B = C^B = 0.24$. Panel (e) uses Cobb-Douglas preferences. We set $\epsilon^i_{j,0} = 0$ and $\rho_j = 0$.

Figure 11: The simulated paths of the production by sector for both Blocks A and B

(a) Block A

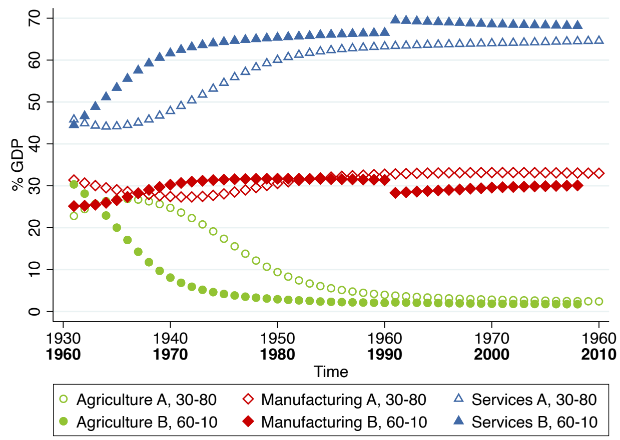


(b) Block B



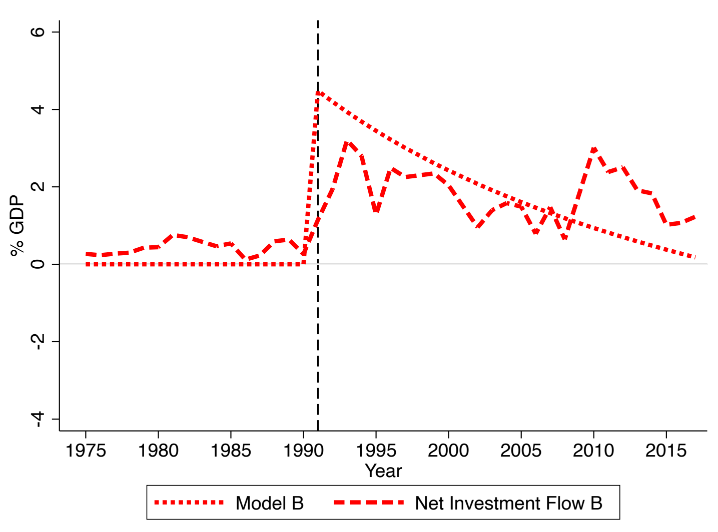
Note: Data Source WDI. Agriculture includes ISIC 1-5, Manufacturing includes ISIC 10-45, and Services includes ISIC 50-99, excluding mining and wholesale trade.

Figure 12: The simulated paths of the production by sector for both Blocks A and B



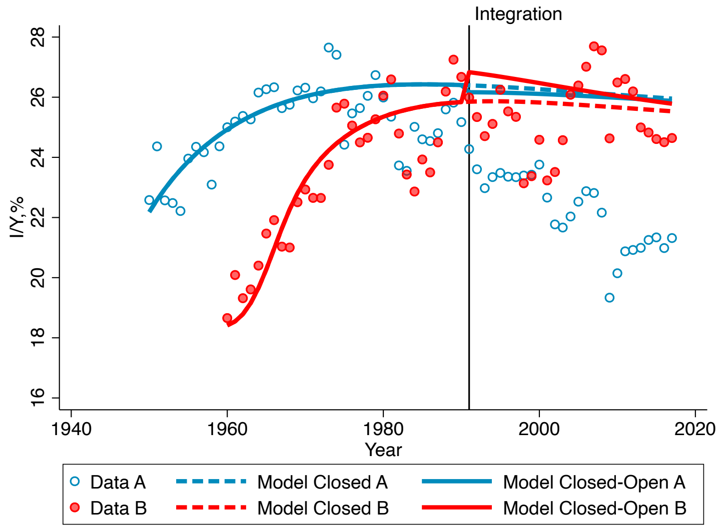
Note: This figure compares the simulated paths of production shares of blocks A and B at different points in time. Lines with circles represent agriculture, lines with diamonds represent manufacturing, and lines with triangles represent services. Blank figures represent production shares for Block A between 1930-1980, and solid figures represent production shares for Block B between 1960-2010. Data Source WDI. Agriculture includes ISIC 1-5, Manufacturing includes ISIC 10-45, and Services includes ISIC 50-99, excluding mining and wholesale trade.

Figure 13: The simulated paths of the private capital flows from Block A to Block B



Note: The dashed line corresponds to the private capital flows from Block A to Block B from the data. We use data from WDI and we define total Capital inflow is defined as net incurrence of liabilities excluding derivatives. Direct + Portfolio investment inflow is defined as net incurrence of direct investment and portfolio investment liabilities. The dotted line correspond to the simulated path of capital inflows from Block A to Block B.

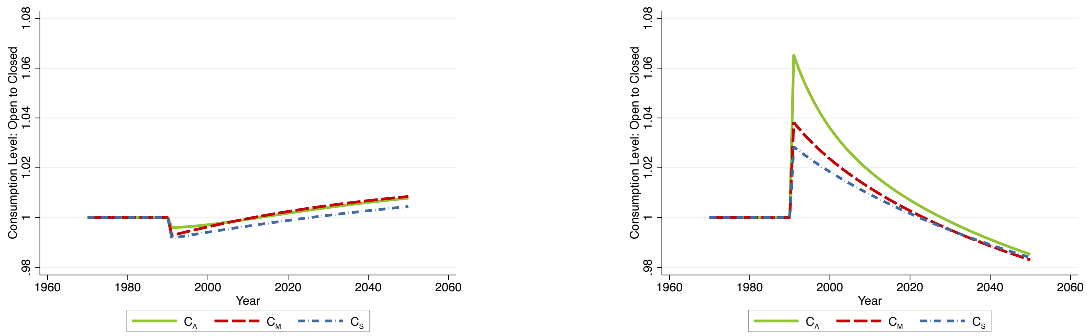
Figure 14: The simulated paths of the investment rate relative to time for both Blocks A and B



Note: Each dot corresponds to an observation in Block j in year t. Data Source: PWT9.1. The solid line corresponds to the simulated results of the closed economy, and the dashed line corresponds to the open economy.

Figure 15: The impact of capital market liberalization on consumption of each of the three goods in Block A and Block B

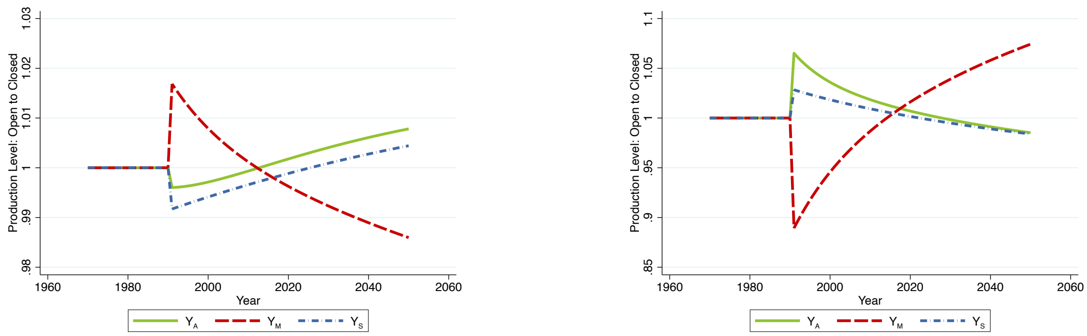
(a) Block A **(b)** Block B



Note: Panel (a) shows the simulated path of consumption in the open economy relative to the simulated path of consumption in the closed economy. Panel (b) shows the equivalent results for Block B. Solid lines represent agriculture, dashed lines represent manufacturing, and dashed-dotted lines represent services.

Figure 16: The impact of capital market liberalization on production of each of the three goods in Block A and Block B

(a) Block A **(b)** Block B



Note: Panel (a) shows the simulated path of production in the open economy relative to the simulated path of production in the closed economy. Panel (b) shows the equivalent results for Block B. Solid lines represent agriculture, dashed lines represent manufacturing, and dashed-dotted lines represent services.

Figure 17a: The simulated paths of output per worker, capital output ratio and relative prices: Block A

(a) Output per worker **(b)** Capital output ratio **(c)** Relative prices

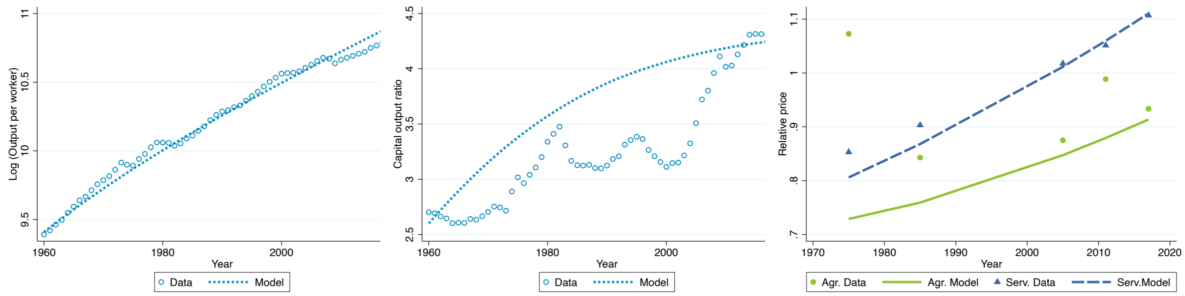
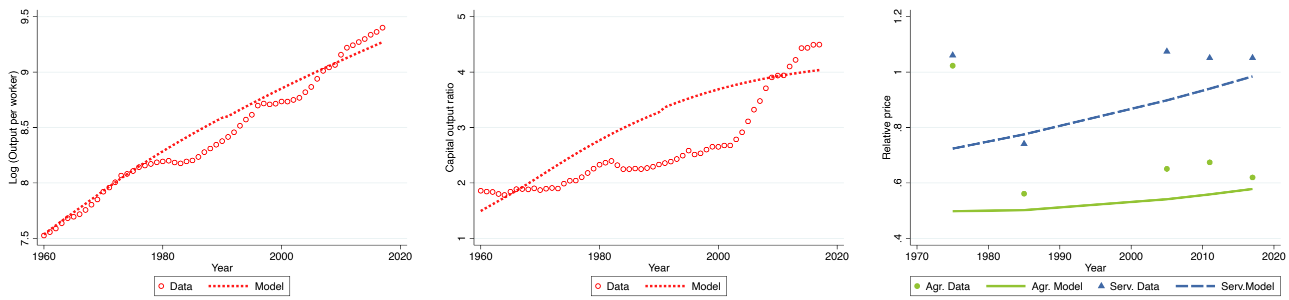


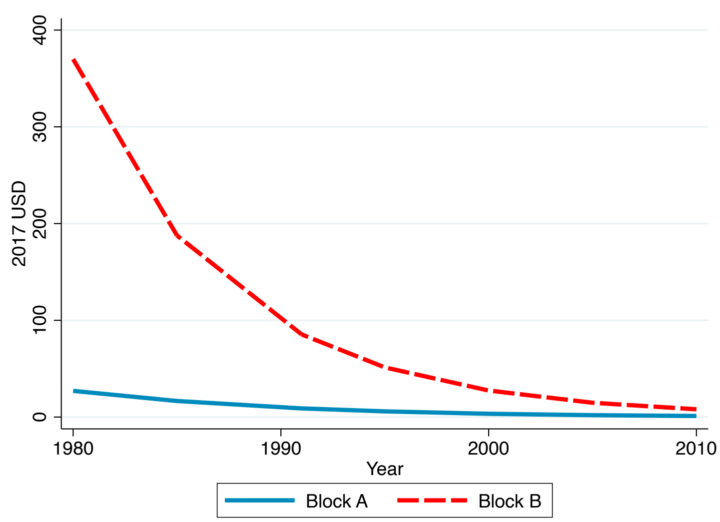
Figure 17b: The simulated paths of output per worker, capital output ratio and relative prices: Block B

(a) Output per worker **(b)** Capital output ratio **(c)** Relative prices



Note: Panel (a) compares the simulated path of output per worker over time with the data. Panel (b) compares the capital output ratio and Panel (c) compares relative prices. We use data from PWT for panels (a) and (b), and data from the ICP to construct relative prices.

Figure 18: The impact of capital market liberalization on welfare in Block A and Block B



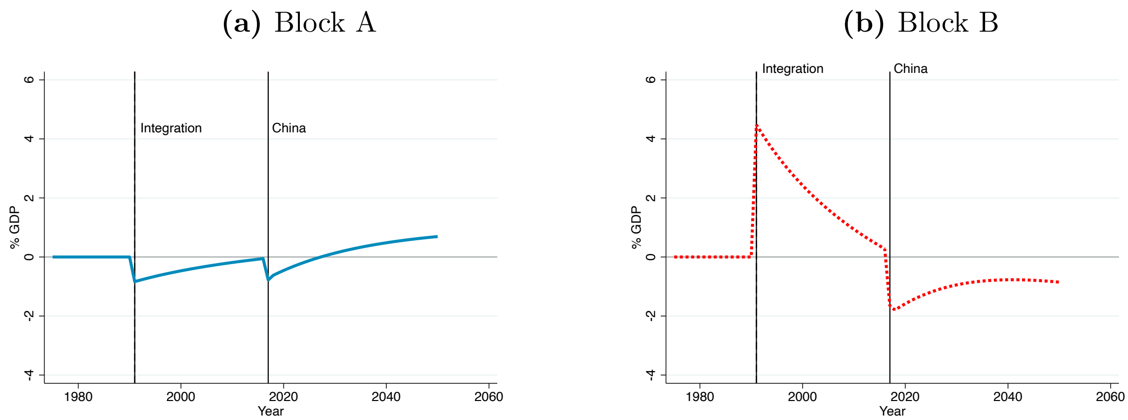
Note: The x-axis shows different opening dates. The y-axis shows the per capita CV in 2017 US dollars. We compute the CV as the present discounted value of expenditure under the open economy since the opening date, minus the presented discounted value of the expenditure required to keep the closed economy utility with the new prices.

Table 6: The impact of capital market liberalization with China on welfare in Block A and Block B

	CV (%GDP)	CV p.c.	EV (%GDP)	EV p.c
		Liberalization		
Block A	0.01%	$8.96	0.02%	$12.86
Block B	0.41%	$85.40	0.36%	$74.50
		Integration with China		
Block A	0.008%	$4.460	0.012%	$6.657
Block B	-1.030%	$-212.858	-1.093%	$-225.934

Note: We compute the CV as $PV\Big((E(U_{\text{Open}}, P_{\text{Open}})\Big) - PV\Big(E(U_{\text{Closed}}, P_{\text{Open}})\Big)$. We compute the EV as $PV\Big((E(U_{\text{Open}}, P_{\text{Closed}})\Big) - PV\Big(E(U_{\text{Closed}}, P_{\text{Closed}})\Big)$. All computations are in 2017 US dollars. CV (%GDP) and EV (%GDP) use GDP of the baseline open economy in 2017.

Figure 19: The simulated paths of capital inflows after integrating with China



Note: Panel (a) shows the simulated path of capital inflows for Block A. Panel (b) shows the equivalent result for Block B. The first first vertical line from the left shows the year of capital market integration between Block A and B. The second vertical represents the year of the integration with China in the counterfacual exercise.

Figure 20a: The simulated paths of savings and investment after integrating with China: Block A

(a) Savings **(b)** Investment

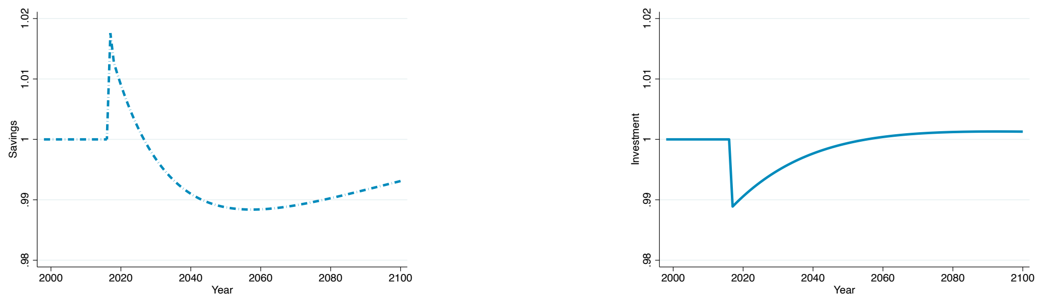
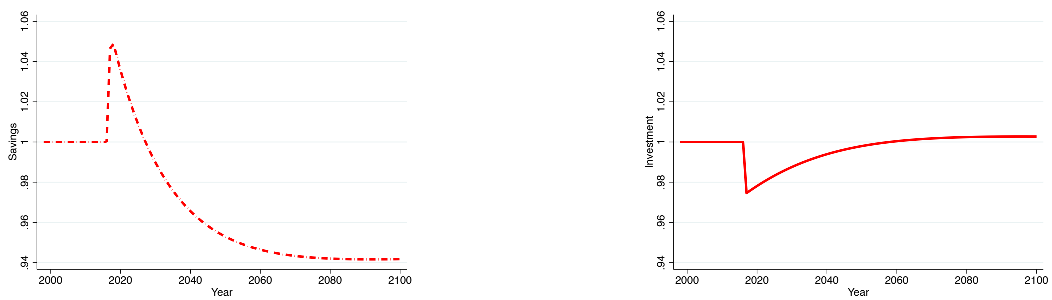


Figure 20b: The simulated paths of savings and investment after integrating with China: Block B

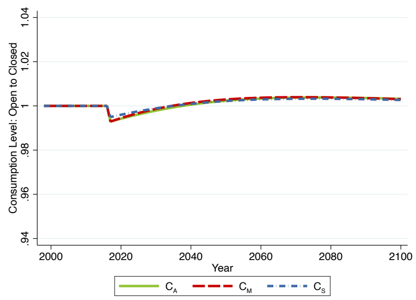
(a) Savings **(b)** Investment



Note: Panels (a) of Figure 20a and of figure 20b, show the simulated path of savings in the counterfactual economy relative to the simulated path of savings in the baseline model. Panels (b) of Figure 20a and of figure 20b, show the equivalent results for investment. Figure 20a show results for Block A and figure 20b show results for Block B

Figure 21a: The simulated paths of consumption and production after integrating with China: Block A

(a) Consumption



(b) Production

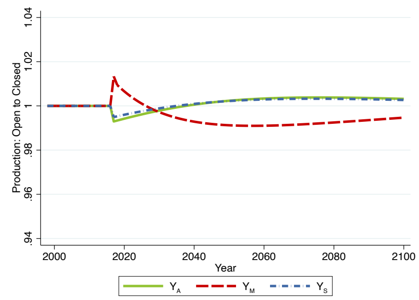
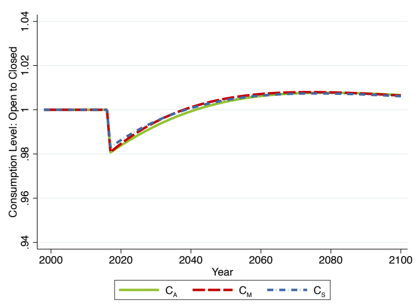
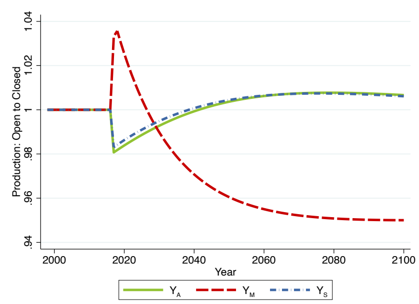


Figure 21b: The simulated paths of consumption and Production after integrating with China: Block B

(a) Consumption



(b) Production



Note: Panels (a) of Figure 21a and of figure 21b, show the simulated path of consumption in the counterfactual economy relative to the simulated path of savings in the baseline model. Panels (b) of Figure 21a and of figure 21b, show the equivalent results for production. Solid lines represent agriculture, dashed lines represent manufacturing, and dashed-dotted lines represent services.