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ABSTRACT

This paper considers the long-run evolution of the world economy in a model in which countries' opportunities to develop depend on their trade with advanced economies. Trade opportunities in turn depend on the relative population of the advanced and developing world. As developing countries become advanced, they further improve the trade prospects for the remaining developing countries. As long as the population growth differential between developing and advanced countries is not too large, the rate at which countries transition to prosperity accelerates over time. However, if population growth differentials are large relative to the transition rate, the world economy converges to idespread prosperity if and only if the proportion of the world population in advanced countries is above a critical level. In our baseline calibration the world economy is below that critical level, but further declines in population growth in the developing world or rapid growth in China would bring it above that threshold. Even then, the share of the world population living in developing countries would decrease very slowly. Substantial narrowing of population growth differentials, increases in the transition rate or the rapid development of India could bring the world economy to a trajectory of accelerating development.

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1 Introduction

For the last half century, integration with the world economy has arguably been the chief route from poverty to wealth. Japan exported cheap goods after World War II and later moved on to more technologically sophisticated products. When Japan became rich, Korea, Taiwan Province of China, Hong Kong SAR and Singapore replaced Japan as low wage exporters, and when these economies moved on to more sophisticated products, Thailand and Malaysia filled their niche. More recently, China has become an important exporter of manufactured goods and India is increasingly moving into services exports. A number of explanations have been advanced for the link between non-traditional exports and growth, most notably learning, such as the gradual move from simple to sophisticated (and higher value-added) goods mentioned above. This paper does not seek to model the reasons for this link, but instead, takes it as given and explores its implications for the long-run evolution of the world income distribution.

We present a model in which countries have an opportunity to develop when they integrate with the world economy producing non-traditional exports for advanced countries. A developing country's export opportunities are greater the more potential buyers there are in advanced countries and the fewer potential competitors there are in developing countries. Thus, as developing countries succeed in becoming advanced economies, their success will improve the export opportunities for the remaining developing countries, which can lead to accelerating global growth. Once China, for example, becomes rich, a billion more people will live in a country that imports labor-intensive goods and a billion fewer in a country that exports them, opening up opportunities for other countries to fill this niche. Whether the world economy converges to a state of widespread prosperity depends on the extent of barriers to trade, the rate at which developing countries that are engaging in trade become advanced economies, migration rates, population growth rates in rich and poor countries, and potentially on initial conditions. Our reduced form model of the world economy takes

the economic transformation process and demographic changes as exogenous parameters and focuses on how their relative magnitude can affect the evolution of the world economy.[1] If the disparity in population growth rates between developing and advanced countries is not large relative to the economic transformation and migration rates, then the proportion of the world population living in advanced countries will increase indefinitely. If the disparity in population growth rates is sufficiently large, then the long-term evolution of the world economy will depend on whether or not the share of the population living in advanced countries (and resulting demand for developing country labor and migration) is above a critical level necessary for the development and migration process to dominate the opposing demographic trend. If it is above (below) that critical level, the proportion of the world population living in advanced (developing) countries increases indefinitely.

A simple calibration of the model suggests that, despite the assumption of one-sided transitions from developing to advanced country status (and migration from developing to advanced countries), disparities in population growth rates are large enough that the proportion of the world population living in poor countries will not decline rapidly. In fact, in our baseline calibration, the competing forces are such that the long-run evolution of the world economy depends on the initial proportion of the world population in advanced countries. This proportion is currently below the critical threshold for the world economy to converge to the favorable steady state. If population growth in the developing world continues to decline faster than in rich countries (as projected by the United Nations), the steady state will become favorable, but convergence will still be extremely slow. Rapid growth in China and India would translate into a large increase in the proportion of the world population in advanced economies, moving that ratio well above its critical threshold. At that point, the

[1] Tamura (1996) presents a model with endogenous choice between fertility and human capital investment, which addresses some of these issues. In his model, as rich countries grow they raise the return on human capital, causing demographic transition and growth in poor countries as they shift from high fertility and low human capital investment to lower fertility and higher human capital investment.

model's non-linearities would become very strong and development would accelerate quickly, ensuring a rapid convergence to widespread prosperity (that is, a convergence that takes decades not centuries).

The model also suggests that improvements in policy that reduce the cost of trade can lead to rapid growth for a particular country, but that the response of world growth to a similar improvement by all developing countries will be much smaller. In our model, a developing country will only start exporting to advanced economies once all the other developing countries with lower costs have already done so. When a country improves its policy environment by reducing tariffs or other barriers to trade, it advances its place in the "queue" of countries waiting to integrate into the world economy. But given the limited capacity to absorb all the labor in the developing world, the speed at which development occurs is itself constrained by the size of advanced economies (and small improvements in the average trade cost will only translate into small gains in global growth). This queuing feature might help explain why growth failed to pick up in many developing countries despite policy improvements in the past decades (for example, much progress has been made in trade liberalization and macroeconomic stability).

Our paper is related to previous studies that have analyzed economic growth in the (very) long-run. Quah (1993) and Kremer, Onatski and Stock (2001) consider a transition matrix analysis of the world income distribution. Lucas (2000) presents a stylized model with an exogenous probability that the process of economic growth begins in a stagnant economy. Once that process begins, growth is proportional to the difference between its income and that of the leading country (which grows at a constant rate). Our model departs from the transition matrix approach in allowing transition probabilities to depend on the state of the world economy. Like the Lucas approach, this tends to generate more optimistic predictions because it suggests that a developing country could potentially do better in the future than countries with similar characteristics have done in the past. However, by allowing for differential

population growth between advanced and developing countries, our model can also generate the prediction that the proportion of the world population in poor countries increases indefinitely.

The remainder of the paper is organized as follows. Section 2 presents the model, Section 3 calibrates the model, and Section 4 concludes.

2 The Model

Suppose there are two types of countries: advanced and developing. For illustration purposes, we assume that the world economy consists of several small countries, which are similar to the other countries of the same type. We later discuss the effects large countries can have on the evolution of the world economy (which is illustrated in Section 3). Section 2.B introduces differences in the barriers to trade across countries.

There are two production technologies: traditional and modern. Labor is the only input and is inelastically supplied. Advanced and developing countries are equally productive in the traditional technology, with each unit of labor producing one unit of the final consumption good. The modern technology includes two tasks: a simple and a complex one. The complex task produces intermediate input H and can only be performed in advanced countries, while the simple task produces intermediate input L and can be performed in either advanced or developing countries. These intermediate goods are then combined to produce the consumption good by competitive firms. Each unit of labor produces one unit of the respective intermediate good. Trade allows the simple and complex modern tasks to be performed in different countries. Thus:

$$\begin{aligned} Y_{traditional} &= n_{traditional,c} \\ Y_{modern} &= AH^{\alpha}L^{1-\alpha} \\ H &= \begin{cases} n_{H,c} \text{ if } c \in advanced \\ 0 \text{ if } c \in developing \end{cases} \\ L &= n_{L,c}, \end{aligned}$$

where $A > 2$, $0 < \alpha < 1$, $n_{traditional,c}, n_{H,c}$ and $n_{L.c}$ are the number of workers in country c engaged in the traditional production and the production of intermediate goods H and L, respectively. Since $A > 2$, it is inefficient for workers in advanced countries to work in the traditional sector.

Trade in intermediate inputs allows modern production to be split among countries. We assume there is a transaction cost associated with producing L in developing countries. Each unit produced involves an additional cost of δ units of the final good, so its production cost is $1 + \delta$. This transaction cost can encompass a number of aspects, which are not explicitly modeled, such as transport costs (for both the good delivered and for the good received as payment), infrastructure problems, as well as policy-related costs such as tariffs, taxation, enforcement of property-rights and the regulatory environment. In our discussion of the model, we will focus mainly on policy-related costs.

In each period, there is a probability that a developing country becomes advanced equal to p times the share of its population working in the modern sector. Each country faces an independent realization of this shock. The economic transformation occurs at the country level and is not internalized in the wages. Thus, modern sector workers in developing countries must be paid their opportunity cost in the traditional

sector.[2] A number of channels could provide micro-foundations for this external learning. Much anecdotal evidence indicates very large spillovers from successful exporting firms to new entrants (for example, Rhee and Belot 1990). These spillovers often involve learning externalities which are impossible for the generating firm to capture (Hausmann and Rodrik 2003). Trade integration can also have political economy implications for learning and productivity growth, for example by weakening forces that resist the adoption of more efficient technologies, as discussed in Parente and Prescott (1994). The productivity gains stemming from the pressure to survive in competitive international markets can potentially be large, as documented by Galdón-Sánchez and Schmitz (2002) for the iron ore industry. We neither model nor take a position on the specific channels through which non-traditional exports trigger learning and economic transformation. Instead, we take that process as exogenous and focus on its implications for the evolution of the world economy. Once a country becomes an advanced economy it remains one from that point onwards.

Natural population growth is γ_A in the advanced countries and γ_D in the developing ones. We focus on the case in which $\gamma_D > \gamma_A$, which has been true since the early 20th century (as shown in Section 3). Finally, we assume that migration takes place from developing to advanced countries. This migration is restricted by the advanced countries to a proportion i of their population.

If the model were to consider relatively large countries, then the realizations of the transformation process in these countries would have substantial implications for the world economy, since they could move sizable shares of the world population from the developing to the advanced group. The larger the size of the countries the more stochastic the evolution of the world economy would become. For simplicity, we assume that the world economy consists of a large collection of very small countries, so that its evolution can be, to a close approximation, described by a smooth and deterministic process.

[2] A benevolent social planner would like to tax the traditional sector in order to subsidize the modern one.

2.1 Evolution of the World Population

In this environment, there are potentially two stages in the evolution of the world population: one where not all developing countries are integrated into the world economy producing for the modern sector and one where they are. We first consider its behavior in the region in which the share of the world population in advanced countries is sufficiently small so that some developing countries are still unintegrated and using the traditional technology.

2.1.1 Stage 1: Not all developing countries are integrated into the world economy.

In this stage there are three groups of countries: advanced countries, developing countries integrated into the world economy, and unintegrated developing countries. Workers from developing countries produce in the modern sector up to the point where the marginal product of their labor is equal to $(1+\delta)$, its alternative marginal product in the traditional sector (their wage is $w_D = 1$) plus the trade transaction cost δ associated with their production. The resulting number N_{DM} of workers from developing countries working in the modern sector is:

$$N_{DM} = (A(1-\alpha)/(1+\delta))^{1/\alpha} N_A,$$

where N_A is the population in advanced countries. The wage in advanced countries, determined by the marginal product of their labor, is:

$$w_A = \alpha A^{1/\alpha}((1-\alpha)/(1+\delta))^{\frac{1-\alpha}{\alpha}}.$$

Note that the cost δ affects w_A but not w_D, since the latter is pinned down by the reservation wage in the traditional sector. However, the cost δ harms the developing population by lowering the demand for L and, as a result, slowing down the trans-

formation process. Also note that even though $w_D = 1$, a developing country that is integrated into the world economy is better-off than one that is unintegrated, since the former may become an advanced economy.

The world population evolves according to:

$$\begin{aligned} \frac{\dot{N}_A}{N_A} &= (\gamma_A + p(A(1-\alpha)/(1+\delta))^{1/\alpha} + i), \\ \frac{\dot{N}_D}{N_D} &= \gamma_D - \left(p(A(1-\alpha)/(1+\delta))^{1/\alpha} + i\right)\frac{N_A}{N_D}. \end{aligned}$$

The proportion of the population in advanced countries will increase and the world economy will eventually move to the second stage where all developing countries are integrated into the world economy and produce in the modern sector if:

$$\frac{\dot{N_A/N_D}}{N_A/N_D} \equiv \frac{\dot{N}_A}{N_A} - \frac{\dot{N}_D}{N_D} = \gamma_A - \gamma_D + (p(A(1-\alpha)/(1+\delta))^{1/\alpha} + i)\left(1 + \frac{N_A}{N_D}\right) > 0.$$

This will be the case if:

$$\frac{N_A}{N_D} > \frac{\gamma_D - \gamma_A}{p(A(1-\alpha)/(1+\delta))^{1/\alpha} + i} - 1, \tag{1}$$

from which follows:

Proposition 1 *If $N_{DM} < N_D$, then N_A/N_D will increase over time if and only if (1) holds. Otherwise, it will converge to zero unless (1) holds with equality.*

Condition (1) becomes less strict the lower γ_D, the higher γ_A, p, i and A, and the lower α and δ. If the population growth differential between developing and advanced countries is sufficiently small, the right-hand side of (1) is negative, N_A/N_D will always increase, and the world economy will eventually reach the second stage. If the population growth differential is large, then the right-hand side of (1) is positive and N_A/N_D will only increase if its starting level is sufficiently high to satisfy this inequality (at which point the transformation process will dominate the demographic

one). Otherwise, N_A/N_D will decline indefinitely, converging to zero (unless (1) holds with equality, in which case N_A/N_D remains constant).

2.1.2 Stage 2: All countries are integrated into the world economy.

Once the world economy moves to this stage where all N_D workers are in the modern sector (i.e., $N_{DM} = N_D$), then:

$$\frac{\dot{N}_A}{N_A} - \frac{\dot{N}_D}{N_D} = -(\gamma_D - \gamma_A) + i\,(1 + N_A/N_D) + p\left(1 + \frac{1}{N_A/N_D}\right), \tag{2}$$

which is a convex second-degree polynomial in N_A/N_D. If:

$$i + p - 2\sqrt{ip} < \gamma_D - \gamma_A < i + p + 2\sqrt{ip}, \tag{3}$$

then the roots of the polynomial are complex and the ratio N_A/N_D will grow without bounds.[3] The condition above is satisfied for the empirically relevant parameter values, as shown in Section 3. Even if (3) does not hold, as long as:

$$(A(1-\alpha)/(1+\delta))^{-1/\alpha} > \frac{\gamma_D - \gamma_A - i - p + \sqrt{(\gamma_D - \gamma_A - i - p)^2 - 4ip}}{2i}, \tag{4}$$

then the largest real root of (2) is lower than the N_A/N_D ratio at the beginning of the second stage, and N_A/N_D still grows without bounds. Condition (4) is more likely to hold when $\gamma_D - \gamma_A$ is small vis-a-vis $i + p$[4]. If neither (3) nor (4) hold, then the

[3] If N_A/N_D grows without bounds, eventually its growth will be lower than the one indicated by (2). For example, at some point $N_D < iN_A$ (i.e., even if all the remaining population in developing countries migrates to the advanced ones, they would still account for less than a share i of the latter).

[4] Note that the right-hand side is negative when $\gamma_D - \gamma_A < i + p$, implying N_A/N_D will grow without bounds (assuming that (3) does not hold, otherwise it would already grow without bounds to begin with).

N_A/N_D ratio converges to a steady-state level given by:

$$\max\left((A(1-\alpha)/(1+\delta))^{-1/\alpha}, \frac{\gamma_D-\gamma_A-i-p-\sqrt{(\gamma_D-\gamma_A-i-p)^2-4ip}}{2i}\right). \tag{5}$$

Thus:

Proposition 2 *If $N_{DM}=N_D$, then $N_A/N_D\to\infty$ if either (3) or (4) hold and N_A/N_D converges to (5) otherwise.*

Regardless of whether N_A/N_D grows without bounds or converges to a steady-state level, once the world economy moves to the second stage where all developing countries are integrated and produce in the modern sector that will remain the case from that point onwards (i.e., they will never switch back to the traditional technology).[5]

Since all developing country workers are producing in the modern sector, their labor has become a scarce resource whose value is no longer pinned down by its opportunity cost in the traditional sector (and will bear the cost δ). As long as workers in advanced countries remain sufficiently scarce that they only produce the H good, the wages in advanced and developing countries are:

$$\begin{aligned} w_A &= A\alpha(N_D/N_A)^{1-\alpha}, \\ w_D &= A(1-\alpha)/(N_A/N_D)^{\alpha}-\delta, \end{aligned}$$

which are increasing in the relative scarcity of the respective type of labor. If N_A/N_D continues to increase, at some point labor in the developing world becomes so scarce that advanced countries start performing the L task. That occurs when N_A/N_D exceeds the relative factor intensity $\alpha/(1-\alpha)$. From that point onwards, the wages

[5]If that was not the case, then (1) would not hold, and the world economy would have never moved to the second stage to begin with. Note that if the world economy had initially started in the second stage, then it would be possible for it to switch to the first one (for example, if the population growth differential is sufficiently large).

in both groups of countries would move in tandem, with $w_A = w_D + \delta$. Thus, the remaining wage premium in advanced countries would only be a result of the transaction cost δ. Note that as a result of that cost, workers from developing countries would still have incentives to migrate to advanced ones.

2.2 Differences Across Countries

The basic model can be extended to include differences in transaction costs across countries. Let δ_c denote the country-specific transaction cost associated with the production of L in developing country c. For simplicity, suppose that the there are many small countries and that the difference in cost across countries is negligible: $\delta_c \approx \delta \ \forall c$. These arbitrarily small differences in transaction costs will not affect the evolution of aggregate populations in advanced and developing countries, but will have strong implications for which developing countries will grow first. Advanced countries will only import L from the developing countries with the higher transaction costs once all of the countries with the lower transactions costs have already joined the modern sector, placing countries in a development "queue." The cost δ_c can encompass variation in transaction costs across developing countries due to policy-related costs, such as tariffs, enforcement of property rights and contracts, distortionary effects of taxation and regulation, and corruption, among others. An individual country can benefit greatly from a small decrease in its cost δ_c, since its growth depends on the ordinal rank of δ_c (e.g., a small improvement can move it to the front of the queue). However, a similar improvement by all developing countries would only translate in a commensurately small improvement for global growth. That is, while infinitesimal changes in δ_c can rearrange the countries' positions in the development queue, the speed at which countries graduate from that queue (which is constrained by the population in advanced countries) will only improve slightly following small changes in the average δ.

If transaction cost differences across countries are significant, the process of global

integration will slow down as it reaches increasingly more costly developing countries. In the extreme case in which a subset of countries have policies bad enough that the resulting transaction cost is $\delta_c > A\alpha^{\alpha}(1-\alpha)^{1-\alpha} - 1$, these countries will never be integrated into the global economy, because the advanced economies would rather produce L themselves than transact with these developing countries. If that is the case, in the absence of migration, the share of the world population living in these countries would grow indefinitely since $\gamma_D > \gamma_A$. However, migration from these countries to advanced ones can compensate for the natural population growth differential if N_A/N_D is sufficiently high. Provided $N_A/N_D > \gamma_D/(\gamma_A + i)$, the global economy will still converge to widespread prosperity.

3 A Simple Calibration

This section calibrates the model by classifying countries as advanced or developing. First, we describe the historical evolution of the world population in these two groups of countries. Then we compute the demographic parameters as well as the rate at which developing countries became advanced, and simulate the future evolution of the world economy. These simulations are performed under different scenarios for the key parameter values.

We use population and GDP data from Maddison (2003) for 1820–2001 and population and international migration data and projections from the United Nations Population Division for 1950–2050.

We classify economies as developing or advanced using as a guideline whether their GDP per capita, measured in 1990 International Geary-Khamis dollar terms, was higher than one-third of that of the "leading country," defined as the United Kingdom for 1820–1900, and the United States afterwards.[6] Since the model assumes

[6]Basing the comparison on the income of the leading country as opposed to say the world average is more suitable to our model and it avoids causing the income threshold to mechanically increase as more countries develop.

one-way transitions from developing to advanced, we focus only on economies that permanently cross that threshold (i.e., they remain above it throughout the end of the sample). Thus, we do not classify as advanced the countries where income was higher than the threshold at some point but later permanently declined below it.[7] Some judgement calls were required in a few instances. For example, countries that cross the threshold multiple times but eventually remain above it are classified based on the initial crossing date, unless the country remained below the threshold for over three years and the decline was not the result of a major war,[8] in which case the classification is based on the later crossing. Former communist countries were always considered developing prior to their transition to a market economy and so are countries whose permanent high income can be attributed to mineral resources. Table 1 lists the economies classified as advanced and the year that classification was assigned, and provides additional details on the classification.

Data coverage is reasonably good for advanced countries, but much more limited for developing ones. The total population in developing economies is constructed as the difference between Maddison's estimates for the world population and the population in advanced economies. Missing observations were log-linearly interpolated. The N_A/N_D ratio increased throughout the 19th century even though only Australia, New Zealand, and Finland joined the advanced economy group, because population growth in advanced economies was considerably higher than that in developing ones (see Figures 1 and 2). In the early 20th century population growth in advanced countries starts to decline while population growth in developing ones increases substantially,

[7] The main countries that experienced prolonged periods above the income threshold and later declined below it were Argentina and Uruguay, whose high income can largely be attributed to primary commodities. Another noteworthy case is Czechoslovakia, which had been above the income threshold since1820 at the time it became a communist country. Hungary and Poland were also above the income threshold prior to World War II and communism.

[8] For example, the following countries classified as advanced declined below the threshold as a result of World War II: Austria: 1945–48, Finland: 1943–45, France: 1942–45, Germany: 1946–48, Ireland: 1942–46, Italy: 1943–47, Japan: 1942–59, Netherlands: 1944–45, and Norway: 1944. Finland also declined below the threshold in 1917–20.

at least in part due to the development of health technology allowing substantial reduction in mortality at low income levels. Following this reversal in the demographic trends, N_A/N_D gradually declines through the 20th century, with blips when major transitions occurred (notably Japan in 1932, and to a smaller extent Spain in 1963, Taiwan Province of China in 1982, and Korea in 1988). Note that N_A/N_D declined despite a substantial increase in the number of advanced economies.

Since transitions from the developing to the advanced economy group are rare, $p(A(1-\alpha)/(1+\delta))^{1/\alpha}$ is estimated by averaging over the last 50 years in the sample (1952–2001) the ratio of the population in the economies that just became advanced to the total population in advanced economies in that year. That yields an estimated $p(A(1-\alpha)/(1+\delta))^{1/\alpha}$ of 0.40%. The average for the 20th century as a whole is 0.37% (the average for the first half is 0.34% and for the second half is 0.40%).[9]

Data on population and migration is available for 1950–2005 through the United Nations Population Division, which also provides forecasts for every fifth year up to 2050.[10] Based on this data, we compute the natural population growth rates γ_A, γ_D and the migration rate i. Both γ_A and γ_D have declined over time, but beginning in the 1990s, the decline in γ_D has accelerated and the $\gamma_D - \gamma_A$ gap has substantially narrowed and is expected to continue to do so, albeit at a slower rate (see Figure 3). Based on 2000–05, the estimated parameter values are: $\gamma_A = .29\%$, $\gamma_D = 1.38\%$ and $i = 0.31\%$. The i estimate includes only developing to advanced economy migration (i.e., it excludes migration from one advanced economy to another).

Based on the demographic parameters above, and $p(A(1-\alpha)/(1+\delta))^{1/\alpha} = .0.40\%$, the right-hand side of (1) is 0.52, which is higher than the current N_A/N_D ratio of 0.17,

[9] As indicated in Table 1, the only transition from developing to advanced in the first half of the 20th century was Japan in 1932. Japan's income declined below the advanced status threshold during 1942-1960 as a result of the devastating effects World War II had on its economy. If we had classified Japan as a developing economy until 1960, the resulting estimate of $p(A(1-\alpha)/(1+\delta))^{1/\alpha}$ for the second half of the 20th century would increase to 0.79%. This higher transformation rate would suggest better prospects for developing countries (and would also suggest that development has become "easier" from the first to the second half of the 20th century).

[10] Taiwan Province of China is excluded from their sample.

suggesting that the proportion of the world population living in developing countries would grow indefinitely. This trend can be reversed if the parameters change over time, lowering the right-hand side of (1), or shocks to N_A/N_D bring it above that critical threshold.

Figure 4 plots the evolution of N_A/N_D excluding China and India under the baseline scenario and under alternative demographic parameters and transformation rates. If the gap in population growth rates between advanced and developing economies narrows according to the projections of the UN Population Division, the world economy will eventually converge to the prosperous steady-state (conditions (1) and (3) would hold). However, that convergence process would be extremely slow and no substantial improvements would take place within a century. As shown in Figure 4, the long-run dynamics could substantially improve through halving natural population growth disparities, doubling immigration or doubling the transformation rate. The transformation rate could potentially change due to improvements in communication and transportation or policy improvements.

This calibration exercise has considered the world economy as a large collection of small countries, whose evolution can be approximated by a smooth and deterministic process. In practice, the transformation of large countries could move sizable shares of the world population from poverty to prosperity. Perhaps the most optimistic interpretation of the model is one in which rapid growth in China and India is seen as a transition to advanced country status in progress. Holding other parameters constant, if China became an advanced country today the N_A/N_D ratio would jump to 0.54, moving it just above the critical threshold. Condition (3) would hold under the baseline parameter values so eventually N_A/N_D would grow without bounds. If both China and India became advanced economies, the N_A/N_D ratio would jump to 1.09. Figure 5 plots the effects of China and of China and India instantaneously becoming advanced economies. In the scenario where both China and India become advanced countries there is a noticeable acceleration in the rate at which other economies de-

velop. This illustrates one of the key features of our model, whereby the higher the population in advanced countries the easier it is for the remaining developing countries to integrate in the world economy. Thus, even if China and India are at the front of the development queue, that could actually benefit other developing countries in the long-run provided these giants transform sufficiently rapidly. This simple exercise, suggests rapid growth in China and India may well be one of the best hope for the medium- and long-run prospects of the rest of the developing world. Their growth should also translate into dramatic terms of trade improvements to the remaining developing (for example, rising prices for primary commodities and for labor-intensive goods, the latter being captured in our model as rising w_D).

4 Conclusion

This paper presented a simple model of trade and development where the prospects for developing countries depend on integration with the world economy. The opportunities for integration improve as the population in advanced countries grows. As developing countries become advanced economies, they no longer compete for export markets with other developing countries, and instead will import from them. This can lead to accelerating global development and widespread prosperity if the difference in population growth rates in advanced and developing countries is small. If that difference is large, widespread prosperity will hinge on whether or not the current share of the world population in advanced countries is above a critical threshold necessary for the transformation and migration processes to dominate the demographic trends.

The model also yields extremely strong non-linearities for growth across countries, where small differences in transaction costs associated with trade can have major implications for which developing countries will grow first. Those combined costs, which can encompass different aspects, including policy-related costs, will rank countries ordinally along a queue where they will wait for their chance to join the global economy.

While policy improvements can move an individual country forward in that queue, the developing country labor that can be absorbed by the global economy is ultimately constrained by the size of the population in advanced countries. As a result, an individual country's growth response to a policy improvement can be much larger than the global growth response to a similar improvement in all developing countries. This can explain why growth has not increased substantially despite dramatic improvements in the economic policies of several developing countries. These results also have interesting implications for the growth prospects of lagging developing regions, such as Africa. It is possible that Africa's prospects will remain limited over the short- and medium-term if it lies behind China and India in the "development queue." But Africa's prospects should improve substantially in the long-run once labor becomes "expensive" in China and India (which should also improve Africa's terms of trade).

The non-linearities in the growth process and threshold effects proposed in this paper suggest that caution should be used when extrapolating the existing empirical evidence on economic growth into the future. Over short horizons, these results are likely to exaggerate the developing world-wide benefits of policy improvements, as some of the observed growth may come at the expense of other developing countries if the queuing effects described are at play. Over longer horizons, these empirical results are likely to be over-pessimistic, as country characteristics that lead to low growth today may allow for high growth if and when the global economy reaches a sufficiently advanced stage. For example, the same policies that make a country unattractive to foreign investors today may not discourage them from investing in the future if that country becomes one of the last places in the world where labor is still "cheap."

The old conventional wisdom was that population growth in developing countries was a major problem. The new conventional wisdom is that population growth is rapidly declining and hence not an obstacle to development. Our results highlight the importance of relative population growth between rich and poor countries. Because

population growth has been declining in the rich world along with the poor world, this population growth gap is relatively persistent. Its worth noting that in our model, population growth in developing countries will create negative externalities on other countries, while population growth and open immigration policies in advanced countries will create positive externalities for the rest of the world. The model suggests that the future of the world economy may well be decided by a race between Asian economic growth and African population growth.

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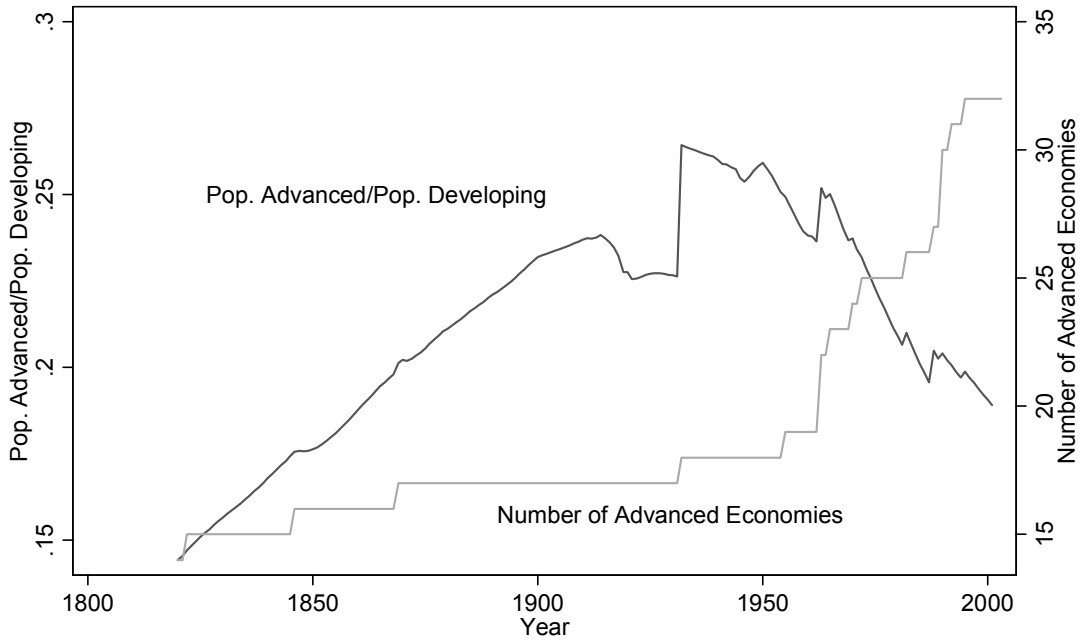
Table 1: Economies Classified as Advanced and Year Classification Assigned.

Economy	Year	Economy	Year
Austria	Entire sample	Australia	1822
Belgium	Entire sample	New Zealand	1846
Canada	Entire sample	Finland	1869
Denmark	Entire sample	Japan	1932
France	Entire sample	Israel	1955
Germany	Entire sample	Hong Kong SAR	1963
Ireland	Entire sample	Puerto Rico	1963
Italy	Entire sample	Spain	1963
Netherlands	Entire sample	Greece	1965
Norway	Entire sample	Portugal	1970
Sweden	Entire sample	Singapore	1972
Switzerland	Entire sample	Taiwan Province of China	1982
United Kingdom	Entire sample	Korea	1988
United States	Entire sample	Czech Republic	1990
		Estonia	1990
		Slovenia	1990
		Mauritius	1992
		Chile	1995

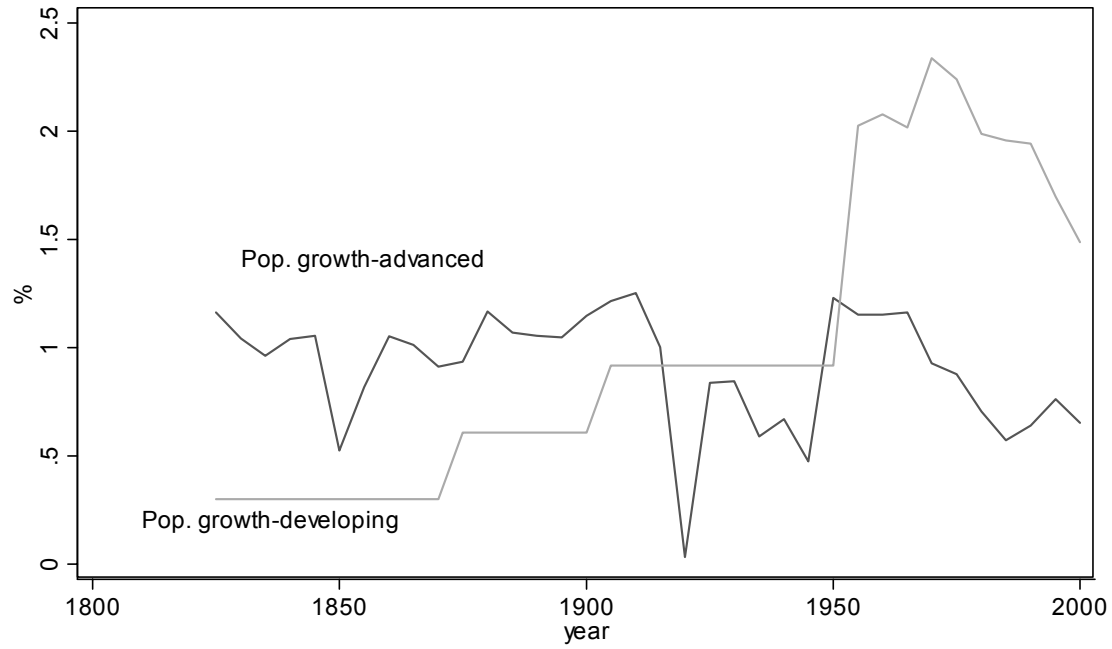
Notes: Classification based on methodology described in Section 3 for calibrating the model. Our classification is different from the standard IMF classification.
Income data from Maddison (2003), covering 1820–2001. Data for Australia and New Zealand available only every 10 years during 1820–70. Their transition years were estimated by interpolation.
Only countries that crossed the income threshold and remained above it throughout the rest of the sample were classified as advanced. Advanced countries that crossed the income threshold multiple times were classified based on the initial crossing date only if the temporary decline lasted 3 years or less (for example, Finland in 1880–82) or can be attributed to a major war: Austria: 1945–48, Finland: 1917–20 and 1943–45, France: 1942–45, Germany: 1946–48, Ireland: 1942–46, Italy: 1943–47, Japan: 1942–59, Netherlands: 1944–45 and Norway: 1944. The following countries experienced prolonged periods of income above the threshold prior to being classified as advanced: Chile: 1900 (or earlier)–1942 and 1946–72, Greece: 1820–50(or later) and 1921 (or earlier)–22, 1925 and 1927–39, Portugal: 1820–55 (or later), 1932–34 and Spain: 1820–1936.
Countries whose continuing high income can clearly be attributed to mineral resources were not classified as advanced: Kuwait, United Arab Emirates and Trinidad and Tobago, which crossed the threshold in 1950 or earlier and Equatorial Guinea which crossed it in 2001 (data for the latter may not be reliable).
Income data from communist countries were not considered.
A number of countries were temporarily above the income threshold, but later permanently decline below it. The main cases were Argentina: 1870 (or earlier)–1984, 1986–87, 1993–94 and 1997–98, and Uruguay: 1870–1966, 1970–71, 1980–81. Venezuela was above the threshold during 1926–98 (but its high income can be attributed to oil). Other noteworthy cases are Czechoslovakia which had been above the income threshold since 1820 at the time it became a communist country, and Hungary: 1870 (or earlier)–1913 and 1925–1940.

Figure 1: Ratio of World Population in Advanced and Developing Economies and Number of Advanced Economies.



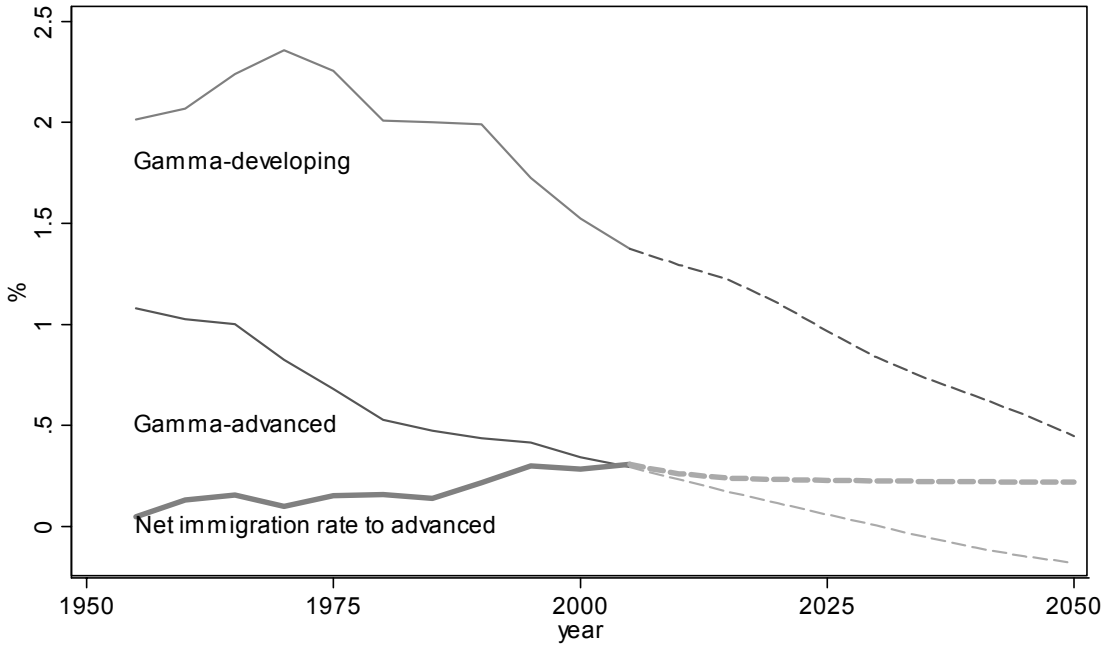
Notes: Data from Maddison (2003). Missing observations log-linearly interpolated.

Figure 2: Population Growth in Advanced and Developing Economies from 1820 to 2000.



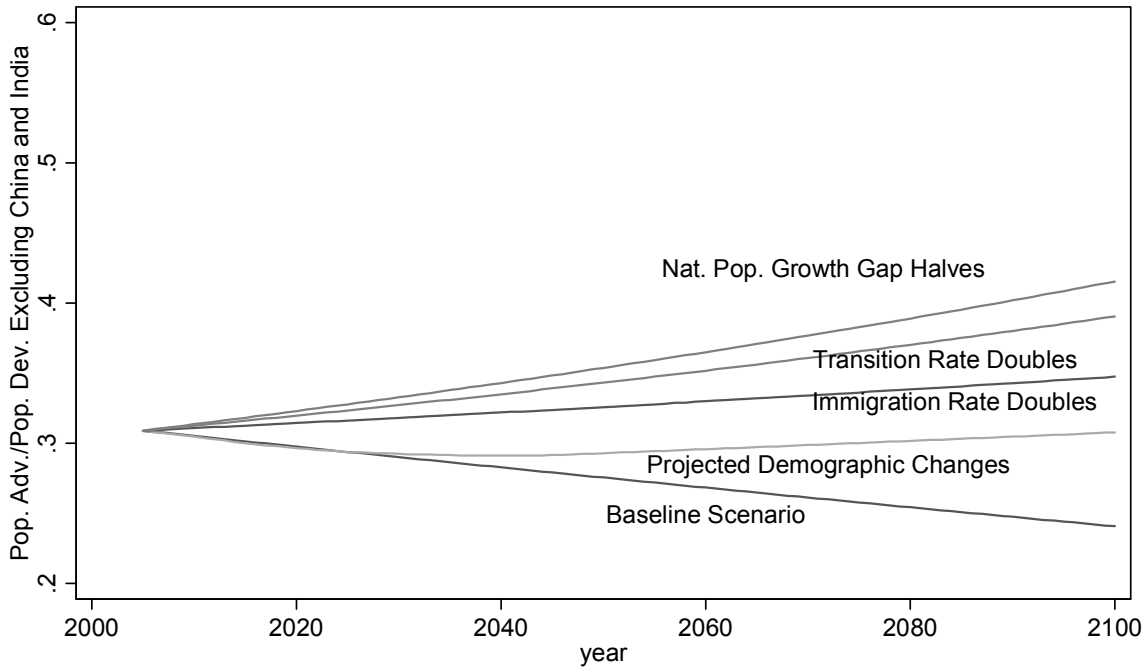
Notes: Data from Maddison (2003). Plot indicates (geometric) average growth over 5 year period ending in that year. Missing observations were log-linearly interpolated.

Figure 3: Natural Population Growth and Net Migration from 1950 to 2005 and Projections for 2005 to 2050.



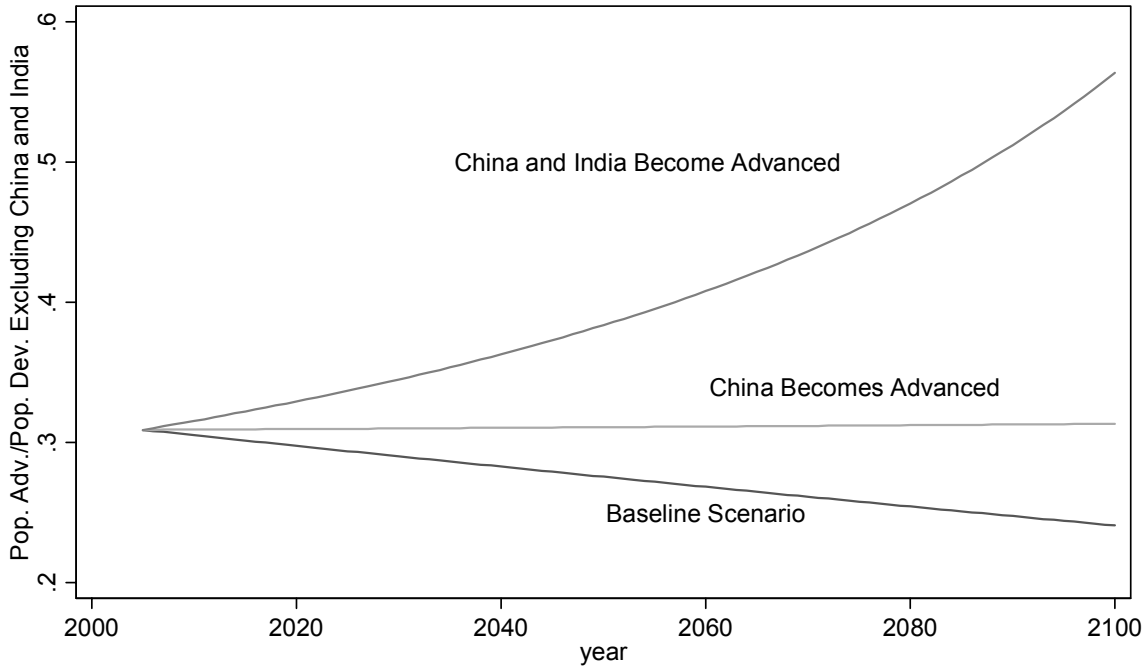
Notes: Data from the United Nations Population Division. Plot indicates average migration rate and the (geometric) average growth rate over the 5 year period ending in that year. Solid lines indicate actual values and dashed lines indicate projections.

Figure 4: Evolution of the Ratio of the World Population in Advanced Economies to the Population in Developing Economies, Excluding China and India, Under Different Scenarios:



Notes: All simulations assume the world economy remains in the stage where not all developing countries produce in the modern sector. The baseline scenario corresponds to demographic parameter values as of 2000–2005, and the historical transition average based on 1952–2001. Projected demographic changes are available through 2050 and parameters values for later years are held constant at their projected 2050 level.

Figure 5: Effect of China and India Instantaneously Becoming Advanced Economies on the Rest of the World.



Notes: Plot indicates evolution of the ratio of the world's population in advanced countries to the population in developing countries excluding China and India. All simulations assume the world economy remains in the stage where not all developing countries produce in the modern sector. The baseline scenario corresponds to demographic parameter values as of 2000–2005, and the historical transition average based on 1952–2001.