FDI, POLARIZED GLOBALIZATION, AND THE CURRENT CRISIS

DAVID MAYER-FOULKES, CIDE, MEXICO

(Preliminary, please do not cite)

Abstract

Even though the current crisis is clearly global, much of the analysis and many of the policy proposals have a single country viewpoint, particularly in the case of the United States. Explanations concentrate, for example on the financial system and on population-wide indebtedment. Here we examine the polarized impact of globalization on economic growth, which arises from the intense interaction between developed and underdeveloped countries, for example between the United States and China.

We construct a Schumpeterian model of economic growth including the main features of globalization: capital accumulation, technological change, trade, and cheap-factor-seeking foreign direct investment (FDI), to analyze the period of globalization from 1980 to 2012. By including innovation externalities between sectors in each country, the two-country model can explain development, underdevelopment and miracle growth. Combining advanced technologies with low costs, FDI yields extraordinary profits that generate asymmetric innovation incentives which explain the following stylized facts. Globalization (a) increases capital accumulation; (b) increases inequality in leading countries; (c) reduces incentives for technological change, (d) generates a two-stage transition path consisting first of FDI expansion to many new sectors and second of balanced or divergent growth of domestic and FDI sectors, and (e) through the flow of extraordinary profits reaches a steady state with a lower interest rate. This transition path linked to globalization leads to an accumulation of savings that served as background to the current financial crisis, and also has important investment turning points.
1. Introduction

For the last thirty years, globalization has been the context of economic growth. Consisting of the liberalization of international trade and investment, globalization has specific features that give economic growth a specific shape. One of the characteristic features of globalization is the interaction between developed and underdeveloped countries. This feature gives globalization its dynamism and global technological change and capital investment a particular, polarized form.

Liberalization tapped a huge potential of economic growth. However, by raising huge profit flows, the surge in growth was also the preamble to the current economic crisis. In addition, globalization is subject to large, qualitative shifts in investment, from expansion of foreign direct investment (FDI) sectors to balanced or divergent growth of domestic and FDI sectors.


The process of globalization was interrupted from 1914 until 1945 because of the two World Wars and the Great Depression. During the postwar period a second stage of globalization emerged, this time led by the United States, with an industrial supremacy based on electrically based mass production. In the postwar era trade and FDI first mainly expanded between the United States and Europe, but then accelerated worldwide in the 1980’s.

This acceleration of globalization began with Ronald Reagan and Margaret Thatcher. Faced with the stagflation crisis of the 1970’s and the first oil crisis, they restarted economic growth by freeing trade and investment. In addition, China’s introduction of market mechanisms in its economy in December 1978, and the fall of the Berlin Wall in 1989, created a global market economy. As free trade and investment treaties proliferated, freer markets and a reduced government role in both developed and underdeveloped countries released a fresh wave of globalization.

Transnational corporations (TNCs) play a central role in the global economy. While aggregate world exports of goods and non-factor services reached U.S. $17 trillion dollars in 2007, aggregate sales of foreign affiliates of TNCs reached U.S. $31 trillion. At $6 trillion, the gross product of foreign affiliates of TNC’s reached 43.7% of US GDP, which is $15 trillion. The relative importance of FDI and trade is reflected in these numbers. The prominent role played by TNCs in globalization has raised their importance and impact on technology transfer, inequality, labor conditions, and the ecology. Thus, implementing global economic policies requires the capacity to regulate the role of TNCs on a global scale. This requires unprecedented global collaboration between governments.

For twenty five years FDI grew at an average real rate of 14.6% a year, while worldwide exports grew at a rate of 6.2%, approximately doubling as a proportion of world GDP from, 14.5% in 1982 to 30.6% in 2006. Liberalization tapped a huge potential of economic growth, which surely is not exhausted, and without which economic growth can now hardly be contemplated. However, the surge in growth
also led to the current, strong crisis, and the importance of FDI imposes its rhythms on the world economy.

The policies that strengthened markets and weakened government in the 1980’s also raised inequality in the U.S. Using IRS tax data, Piketty and Saez (see web page) have shown that, while the bottom 90% has seen their income share drop from 66.8% in 1982 to 54.7% in 2006, the top 10%, 1%, 0.1% and 0.01% income brackets saw their income shares multiplied by 1.4, 2.3, 4.1 and 6.4 respectively (excluding capital gains!). The income shares of these income brackets were 45.3%, 18.0%, 8.0% and 3.4% respectively in 2006. The share of national income going to wages and salaries fell to 51.6% in 2006, its lowest recorded level, with data going back to 1929. The share of national income captured by corporate profits, in contrast, rose to its highest recorded level, 13.8% (Aron-Dine and Shapiro, 2007). Income inequality evokes Third World imagery ever more strongly in the US (e.g. Brooks, 2008).

1.1. **Globalization and economic growth.** Let us brief review how globalization works and why it is a potent economic force. Economic growth is the increase in the amount of the goods and services produced by an economy over time, public and private. Two decades of research on economic growth show that differences in per capita incomes between countries are mainly driven by differences in technological levels. Hence the engine of economic growth is technological change, which in turn drives capital accumulation. Globalization consists of the integration of national economies through trade and FDI. While migration was an important element of globalization in the 19th Century, it has been restrained in the present wave of globalization. So, what are the driving forces in the current period of globalization and how do they impact economic growth?

First, trade is driven by comparative advantage. Countries specialize in the sectors they are most productive at, given their technological levels, and thus increase their income by trading. This is a static effect that would soon reach equilibrium in the absence of technological change. Technological change itself is driven by the incentives for profits and market power that come with developing and owning new production techniques, product lines and so on. This market power gives rise to large corporations that subsist through sequential innovation. In addition to trade, globalization is driven by foreign direct investment. Firms invest abroad seeking cheap labor, cheap raw materials, new markets for their goods, and more efficient arrangements of production. When approximately equal partners such as European countries and the US engage in trade and FDI, countries specialize in those sectors for which they have a comparative or a technological advantage. Production takes place more efficiently and for larger markets. The incentives for innovation increase, thus raising not only the levels of production but also long-term economic growth. Economic well-being tends to grow in parallel across these countries. I do not model this type of FDI, which tends to function as an extension of domestic production abroad, following sector-specific specialization. In the model, its impact on production and innovation would not differ too much from the impact of trade, unlike the case of cheap-factor-seeking FDI.

When instead quite unequal partners engage in trade and FDI, specialization also occurs according to the costs of factors of production such as labor and capital. In these circumstances a polarized, asymmetric form of globalization emerges. Developed countries with high wages invest in underdeveloped countries, seeking low
wages. Large transnational corporations emerge that obtain extraordinary profits as they purchase cheap labor and cheap resources in backward countries and sell their products in advanced countries. Because more workers are now using better technologies, overall productivity rises. However, extraordinary profits need not raise the incentives for innovation, because under lower costs innovation yields lower cost savings, as shown below. In the theoretical model we concentrate on cheap-factor-seeking FDI.

Polarized globalization leads to imbalances both in developed and underdeveloped countries. In developed countries, workers have now to compete with lower-salaried workers elsewhere, endangering the middle class, while capital and technology tend to receive higher returns, as noted above. On the other hand, underdeveloped countries competing with each other for the investments of TNCs that export their profits may find it hard to raise taxes for funding public goods. They may also find it hard to compete in innovation. Because advanced economies are large and innovate in many sectors, backward economies may remain technologically dependent, reaching an equilibrium technological lag that itself constitutes underdevelopment. Thus, it is possible for globalization to generate a global economy that can remain persistently polarized into high and low steady states and the same time accumulate capital faster than under autarky.

Alternatively, when there is enough technological transfer, “miracle” growth may occur. Indeed, the majority of countries that attained industrialization and development did so through a prolonged period of high, sustained economic growth. Such are the cases of Denmark, Sweden, Italy, Japan, South Korea, Taiwan, Hong Kong, Singapore, Ireland, Germany in the 19th century, Western Germany after the War, Cyprus, Iceland, Spain, Malta, Portugal, Israel. In Wan’s (2004) comparative case studies of the Asian Tigers’ growth experiences, the reference convergence trajectories include at least two decades of growth higher than 5%, viewed explicitly as a transition to a higher stationary state. This possibility of miracle growth represents a hope for hundreds of millions of people for emerging from poverty. For this reason Wan considers the East Asian rise to development one of the mega-events of the 20th Century. However, some countries have experienced periods of miracle growth without fully reaching development, such as Argentina, India, Nigeria, Brazil, and Mexico in the sixties and seventies. What the outcome will be for the current cases of China and India remains to be seen. If these countries can rise from poverty, the rest of the underdeveloped world would surely follow. When countries become equal partners, welfare rises, countries specialize in different sectors of production, and workers from advanced countries cease to face competition from low salaries. Also, more resources become available for innovation, so economic growth rises. This was the case in the relation between the Asian Tigers and the US.

1.2. The stylized facts. We construct a model that explains the following stylized facts.

(a) Globalization increases capital accumulation.
(b) Development, underdevelopment and miracle growth can all coexist under globalization.
(c) Globalization increases inequality in leading countries.
(d) Along the transition path generated by the introduction of globalization, the global interest rate will diminish.
Globalization has two characteristic modes. In the first, “sectorial expansion of FDI”, FDI expands to many new sectors of the economy. FDI grows at the expense of domestic investment in leading and lagging countries. In the second, balanced or divergent growth occurs between domestic and FDI sectors.

The chief dynamic factor of globalization is cheap-factor-seeking FDI. This type of FDI has played a very large role in the recent wave of globalization. It obtains higher than normal profits and at the same time experiences lower than normal incentives for innovation. Both of these characteristics are rooted in its lower than normal costs.

The high rates of capital accumulation of cheap-factor-seeking FDI and its simultaneous slower rates of innovation led to a lower steady state interest rate that eventually destabilized the financial system in the current crisis (Mayer-Foulkes, 2009a). Bernanke (2005) raised a “savings glut” hypothesis that is supported by an examination of US Treasury Bill interest rates minus inflation (Figure 1). Real long-term interest rates, represented by the yields for 20 (and 30) year bonds, decreased significantly (the confidence levels for these coefficients are far better than the 1%), on average 15 (respectively 18) basis points per year, reaching about 1.6% in 2006 and 2007. This is consistent with a decrease of the returns to investment in the US over this period, and with the emergence of the saving glut during the last few years.

To explain these stylized facts, our model incorporates the main aspects of long-term global dynamics. First, capital accumulation, a direct concern here because of its connection with the financial crisis and cyclical growth. Second, technological change, since a decade of empirical and theoretical studies has it as the fundamental motor of economic growth. Third, the model includes institutional quality and other economy-wide publicly provided goods, also considered fundamental components of long-run economic growth (e.g. Acemoglu, Johnson and Robinson, 2004).
Institutional quality is modeled with a deep, long-term component and also a component depending on the levels of institutional expenditure and innovation.

Next, the model incorporates the main components of globalization, which are trade and cheap-factor-seeking foreign direct investment (FDI). These allow production to be assigned according to comparative advantage, and technologies to flow across international boundaries. However, the international assignment of production implies also an international assignment of innovation. While in general technological transfer implies an advantage of backwardness generating convergence (Gerschenkron, 1952), I show that trade and FDI can focus innovation in leading countries, thus generating asymmetric innovation incentives, a disadvantage of backwardness, that makes technological differences between advanced and lagging countries be persistent. The mechanisms are the following.

Trade will distribute production sectors across countries in proportion to aggregate productive capacity, allocating sectors according to comparative productivities. Thus, more advanced and larger countries will produce in and therefore innovate for a proportionally higher number of sectors. When there are positive innovation externalities between sectors, for example due to shared public goods such as scientific and educational infrastructure and to cross fertilization in sectorial knowledge production, this will generate asymmetric innovation incentives favoring advanced countries.

Cheap-factor-seeking FDI combines advanced technologies with low labor costs, generating extraordinary profits. As we shall see, these TNC profits played a major role in the savings glut. In addition, FDI generates asymmetric innovation incentives between advanced and lagging countries, by transferring innovation sectors from lagging to advanced countries. On the other hand, FDI generates technological spillovers that can increase technological absorption in host countries. Mayer-Foulkes and Nunnenkamp (2009) show over a sample of countries that outward US FDI contributes to convergence in developed countries, but to divergence in underdeveloped countries.

When trade and cheap-factor-seeking FDI generate sufficiently strong asymmetric innovation incentives favoring advanced countries, lower steady states appear that represent underdevelopment. Correspondingly, development is represented by higher steady states and miracle growth by changing from a lower to a higher steady state, a process that can be set off by changes in economic policies, institutions or circumstances.

Note that high FDI profits tend to concentrate income at the highest levels of the income distribution, and therefore tend to increase inequality in leading countries. Further, when labor costs are cheaper, incentives for innovation are lower. It can therefore be expected that FDI impacts capital accumulation more than technological change.

1.3. Impacts of globalization on the US economy. Our model is consistent with the huge profit flows from the underdeveloped to the developed world. Once FDI expansion slowed, corporations decided to save much of this flow, and therefore placed it in the financial system of the developed world, mainly in the US. Our model predicts such and investment shift when a period of FDI expansion ends.

Because US corporations avoid taxes by keeping their profits under their foreign subsidiaries’ names, the profit flow is assigned in national accounts to the US
trade deficit. The trade deficit ballooned to 5.8% of GDP in 2005 and 2006. Figure 2 shows the close relationship between the profits of foreign affiliates of US corporations and the US trade deficit.

This “savings glut” (Bernanke, 2005) led to capital account inflows in the United States, Spain, the United Kingdom, Australia, Italy and France, and then to substantial housing appreciation setting the stage for the stock market crisis.

Corporate profits reached an all time high in the US and the UK, as well as many corporations across the world. The World Investment Report highlights increased profits of foreign affiliates for 2007, notably in developing countries (UNCTAD, 2008, page 4). It explains that, “as TNCs in most industries had ample liquidity to finance their investments, reflected in high corporate profits, the impact (of sub-prime mortgage crisis that erupted in the United States in 2007) was smaller than expected. The aggregate profits of TNC’s foreign affiliates reached $1,100 billion in 2007, with profit rates of about 7%, calculated as ratio of net income to total sales (ibid). These profits were increasingly generated in developing countries rather than in developed countries. About 30% were reinvested and the rest repatriated, in an amount that is remarkably close to the US capital account surplus. The economic importance of FDI profits is of the same magnitude as the US trade deficit.

The overall picture of high global corporate profits, high earnings for the top income levels, a falling participation of income for salaried workers in advanced countries, and transfers of 70% of affiliate profits to their home countries, is consistent with the role described above for FDI under polarized globalization.

What is especially notable, however, and is one of the roots of the present financial crisis, is that this repatriated income was not invested. Instead it remained in the financial system of the developed world, tending to overvalue it, and feeding housing appreciation through many countries. The lack of investment was noted by Krugman (2007) in an editorial column, which made reference to a “double

---

**Figure 2.** Profits of foreign affiliates of US corporations and the US trade deficit.
disconnect:” “high profits haven’t led to high investment, and rising productivity hasn’t led to rising wages.” Higher profits did not lead to higher innovation either, as noted here.

The prevalence of low interest rates and a lot of money chasing a limited investment portfolio is evidenced by the emergence of the derivatives bubble. According to the Bank of International Settlements (BIS), world’s clearinghouse for central banks in Basel, Switzerland, the valuation of the world’s derivatives grew exponentially from $72 trillion in June 1998 to $683 trillion in June 2008, in real terms multiplying by 5.8 and growing at an annual rate of 19.5% a year. This truly astronomical figure, a sum of “investors’” wagers, compares to: US annual GDP of about $15 trillion, US government’s maximum legal debt of $9 trillion, world GDP of approximately $50 trillion, total value of the world’s real estate estimated at about $75 trillion and total value of world’s stock and bond markets at somewhat above $100 trillion.

The rest of the paper is organized as follows. Section 2 gives the model. Section 3 concludes.

2. The model

The Schumpeterian model presented here builds on a series of papers. These first introduce endogenous technological change in the theory of economic growth (Aghion and Howitt, 1992); then show that technological transfer can induce convergence (Howitt, 2000); and finally go on to address problems that can generate divergence and underdevelopment. Human capital thresholds for R&D can separate implementing from R&D countries into convergence clubs and explain long-term divergence (Howitt and Mayer-Foulkes, 2002). Financial development can determine technological absorption rates and also explain long-term divergence (Aghion, Howitt and Mayer-Foulkes, 2005). Also, the human development trap and geographical factors can interact with these low technology traps (Mayer-Foulkes, 2008, 2009b, c, d). The present model includes trade and foreign direct investment, demonstrating first that these can give rise to convergence clubs and divergence, and second, how the introduction of globalization can lead to a decrease in the steady state interest rate.

A series of assumptions are made in the model for the sake of simplicity. We consider a two-country model, a leading developed country and an underdeveloped country with a lower technological level. Next, because we want to analyze the long-term behavior of the interest rate, we include not only technology levels but also capital in the model, making it a model with several variables. For simplicity we therefore opt for writing a continuous Solow-style model. This also has the advantage of making the model more accessible to non-specialists in endogenous technological change. The Solow-style model is endogenous in that it can be derived from myopic preferences generating saving and infinitesimal foresight generating technological change. Because we analyze trade and FDI, we use a continuum of goods (called sectors), as is also common in endogenous growth models seeking to smooth innovation probabilities. However, we also abstract from innovation uncertainty, again for simplicity. Since the main motor of the effect we are looking at is FDI, we do away with comparative advantage in trade. It would not be hard to include this in the analysis, by introducing a gradient of productivity fixed effects
across sectors, moving in opposite directions for the two countries (as in Mayer-Foulkes, 2009c). We comment on the implications that would arise from including it.

Another simplification from more standard models in technological change is that rather than postulating a leading technological edge we take the leading country’s technology as the leading edge that a more backward country can adopt. This eliminates another state variable. Innovation is understood as a wide spectrum of activities, from adoption at the lower end of the spectrum to R&D at the top level. A given rate of technological change costs in proportion to the technological level. Hence a constant steady state rate of growth is possible, obtained by expending a constant proportion of income on innovation. More backward countries enjoy the “advantage of backwardness” consisting of adopting more advanced technologies (Gerschenkron, 1952). This generates convergence. However, disadvantages of backwardness may result from other aspects of the technological dynamics.

One of the properties of these models of technological change is that they generate two types of steady state divergence. The first is divergence in levels, when there is an equilibrium lag in technological levels. The second is divergence in growth rates, when this lag becomes progressively larger, with the lagging country growing at a slower rate than the leading country.

2.1. Production. Economy 1 and Economy 2 produce a continuum of tradeable goods indexed by \( i \in [0, 1] \), where each \( i \) refers to a sector.

There is a single innovator in each sector who invests in innovation, innovates with certainty, and becomes a national or world monopolist, under autarky or trade, producing in the presence of a competitive fringe. We assume that innovation is cheaper for the producing incumbent than for the competitive fringe, who therefore has an innovation advantage both in autarky and under trade, and whose monopoly therefore persists indefinitely so long as her sector is assigned by trade for production in her economy.

Assume that on an exogenous subset of sectors \([0, \xi_{FDI}]\) it is feasible to conduct cheap-factor-seeking FDI. We assume that on these sectors innovators from Economy 1 producing in Economy 2 will out compete domestic producers from both countries, the reverse not holding for innovators from Economy 2.¹

Under autarky all goods are produced domestically and each economy produces in all sectors. Under free trade and FDI, in every sector innovators produce monop\-olically, supplying world consumption and investment. FDI production on sectors \([0, \xi_{FDI}]\) (with \( \xi_{FDI} \leq \xi_{FDI} \)) is carried out by Economy 1 innovators in Economy 2. Domestic production in Economy 1 corresponds to sectors \((\xi_{FDI}, \xi_{FDI} + \xi_{1t})\), and in in Economy 2 to sectors \((\xi_{FDI} + \xi_{1t}, 1)\). Let \( \xi_{2t} = 1 - \xi_{FDI} - \xi_{1t} \). Then Economy 2 produces and innovates domestically on set \((1 - \xi_{2t}, 1)\), and

\[
\xi_{FDI} + \xi_{1t} + \xi_{2t} = 1. \tag{2.1}
\]

I refer to the variables \( \xi_{1t}, \xi_{2t}, \xi_{FDI} \) as the sectorial measures of the domestic and FDI sectors. Below we shall assume globalization begins at \( t = 0 \) with \( \xi_{FDI_0} < \xi_{FDI} \). Capital will accumulate in this sector and tend to raise \( \xi_{FDI} \) until it reaches

¹The definition of FDI extends to the case when innovators from Economy 1 subcontract production to firms in Economy 2, innovators retaining all profits. Intermediate cases can also be dealt with.
\( \xi_{FDI} \). If FDI employs all of the working population of Economy 2, this economy will be “dominated by FDI” (a banana republic).

**Definition 1.** The production function for domestically produced goods in sectors \( \eta \in (\xi_{FDI}, 1] \) in Economy \( j \) is the Cobb-Douglas:

\[
y_{jt}(\eta) = k_{jt}(\eta)^\alpha \left( Q_{jt}^\beta A_{jt}^{1-\beta} l_{jt}(\eta) \right)^{1-\alpha}, \quad j = 1, 2.
\]

The production function for FDI (produced by innovators from Economy 1 in Economy 2) is:

\[
y_{FDI}(\eta) = k_{FDI}(\eta)^\alpha \left( Q_{FDI}^\beta A_{FDI}^{1-\beta} l_{FDI}(\eta) \right)^{1-\alpha}, \quad \eta \in [0, \xi_{FDI}].
\]

Here \( y_{jt}(\eta) \) is the amount produced in sector \( \eta \), \( k_{jt}(\eta) \) is the amount of physical capital (a composite good to be defined below) employed in the sector, \( Q_{jt} \) is an economy level public good, \( A_{jt} \) is the technological level of the given economy, and \( l_{jt}(\eta) \) is labor employment. Observe that assuming that there are different technological levels in each economy implicitly assumes that mastering foreign technologies and adapting them to the local environment is costly.

We suppose that public goods are supplied as a flow that is proportional to the technological level, whether they are institutions or services,

\[
Q_{jt} = q_j A_{jt}.
\]

Institutional quality is thus thought of as the result of continual innovation adapting publicly provided service to conditions changing with the arrival of new technologies. Services maintaining property rights, for example, need to be provided in concordance to the technological level to be effective. Here \( q_j \) is a constant which can be thought of as a measure of a deep, country-specific institutional kernel. Institutions can also be understood to include government provision of services raising human capital, infrastructure, and other goods not fully provided by private markets.

**Definition 2.** Define the domestic and FDI productivities

\[
B_{jt} = Q_{jt}^\beta A_{jt}^{1-\beta}, \quad B_{FDI} = Q_{FDI}^\beta A_{FDI}^{1-\beta}.
\]

and the relative state variables

\[
a_t = \frac{A_{2t}}{A_{1t}}, \quad q = \frac{q_2}{q_1}, \quad b_t = \frac{B_{2t}}{B_{1t}} = \frac{Q_{2t}^\beta A_{2t}^{1-\beta}}{Q_{1t}^\beta A_{1t}^{1-\beta}} = q^\beta a_t, \quad \lambda_t = \frac{L_{2t}}{L_{1t}},
\]

\[
b_{FDI} = \left( \frac{B_{2t}}{B_{FDI}} \right)^{1-\alpha} = \left( \frac{Q_{2t}^\beta A_{2t}^{1-\beta}}{Q_{FDI}^\beta A_{FDI}^{1-\beta}} \right)^{1-\alpha} = a_t^{(1-\beta)(1-\alpha)}.
\]

Here each economy has population \( L_{jt} \). Since it is assumed that \( A_{2t} \leq A_{1t} \), it follows that \( a_t \leq 1 \) and \( b_{FDI} \leq 1 \). Hence FDI is feasible, since \( B_{2t} < B_{FDI} \). If also \( q \leq 1 \), \( B_{2t} \leq B_{1t} \).

We shall consider several sectors of production each with some level of capital assigned to it, and with different rates of return. We extend the notation so that subindices can range over \( \{1, 2, FDI\} \).
Proposition 1. Given wages $w_{jt}$ and interest rate $r_{jt}$, the production cost of each unit of domestic good $\eta$ is:

$$z_{jt}(\eta) = \frac{r_{jt}^\alpha (w_{jt}/B_{jt})^{1-\alpha}}{\alpha^\alpha (1-\alpha)^{1-\alpha}}, \quad j \in \{1, 2, FDI\}.$$  \hfill (2.6)

The ratio of capital to labor is:

$$k_{jt}(\eta) = \frac{\alpha w_{jt}}{l_{jt}(\eta)}, \quad j \in \{1, 2, FDI\}.$$  \hfill (2.7)

Each domestic sector produces monopolistically (with or without a competitive fringe) with a markup $\chi > 1$, selling at a price:

$$p_{jt}(\eta) = \chi z_{jt}(\eta), \quad j \in \{1, 2\}.$$  \hfill (2.8)

This is a common assumption in models of endogenous technological change.

The competitive fringe also provides reserve employment and capital investment opportunities at current interest rates and wages.

To simplify the transitional analysis we assume that capital flows perfectly across sectors so that interest rates equalize across sectors.

Because the production function, interest rate and wages are equal across each domestic sector and across FDI sector, capital and labor quantities are equal within these sectors.

Notation 1. In view of the constancy of basic quantities across sectors of the same type, we now eliminate $\eta$ from much of the notation, as follows. $l_{it}(\eta) = l_{it}$, $k_{it}(\eta) = k_{it}$, $i \in \{1, 2, FDI\}$, and similarly for other variables.

It follows that

$$Y_{it} = \xi_i y_{it} = K_{it}^\alpha (B_{it} L_{it})^{1-\alpha}$$

$$= \xi_i \left( \frac{K_{it}}{\xi_i} \right)^\alpha \left[ B_{it} \frac{L_{it}}{\xi_i} \right]^{1-\alpha} = \xi_i k_{it}^\alpha (B_{it} L_{it})^{1-\alpha}, \quad i \in \{1, 2, FDI\}.$$  \hfill (2.9)

Our main state variables are $K_{it}, L_{it}, \xi_i$.

2.2. Trade and FDI. Under trade and cheap-factor-seeking FDI, production responds to global demand, and global prices are formed. Let the instantaneous consumer subutility function $C_t$ for an agent consuming $c_t(\eta)$ units of sector $\eta$ goods, $\eta \in [0, 1]$, be the Cobb-Douglass:

$$\ln (C_t) = \int_0^1 \ln (c_t(\eta)) \, d\eta.$$  \hfill (2.9)

Suppose also that investment uses a composite good with the same kernel as consumption, so that the sectorial compositions of consumption and investment demand are equal. Then aggregate world expenditure across sectors is will be constant. Because prices will also be constant across sectors, so will production.

Comparative advantage can be introduced in the model (see Mayer-Foulkes, 2009c) by introducing a fixed sectorial productivity effect that decreases along $\eta$ for Economy 1 and increases for Economy 2. Then comparative advantage combines with technological advantage to determine some equilibrium $\eta = \xi_{FDI} + \xi_{it}$ on $[\xi_{FDI}, 1]$ so that sectors on $[\xi_{FDI}, \xi_{FDI} + \xi_{it}]$ are produced in Economy 1 while sectors in $[\xi_{FDI} + \xi_{it}, 1]$ are produced in Economy 2. Trade thus increases aggregate productivity and consequently also makes more resources available for innovation.
However, the present model emphasizes the role of FDI, so for the sake of simplicity comparative advantage is not introduced, first, to eliminate mathematical complexity, and second, so as not to have to make assumptions about the relation between comparative advantage and FDI. (We can still imagine there is a small fixed sectorial productivity effect that decreases along $\eta$ for Economy 1 and increases for Economy 2.)

Assume now that Economy 1 technologies are beyond the reach of Economy 2 competitive fringe producers. Hence the competitive fringe for FDI producers consists of domestic producers in Economy 1. We assume that these are small producers who can trade but cannot afford to produce abroad. It follows that FDI products are sold at the same prices as Economy 1 domestic products.\(^2\)

We now work out how production is allocated across the two economies.

**Proposition 2.** Prices and quantities of production are constant across sectors. Hence

\[
(2.10) \quad \xi_{it} = \frac{Y_{it}}{Y_{1t} + Y_{2t} + Y_{FDIt}}, \quad i \in \{1, 2, FDI\}.
\]

Proof. The boundary $\xi_{FDIt} + \xi_{1t}$ of the set of domestic sectors is determined endogenously and would shift to the right or to the left if $p_{1t}$ were different to $p_{2t}$ (by attracting more domestic sectors into production in the economy offering the cheaper price, since domestic capital is fungible) except possibly in the boundary cases $\xi_{1t} \in \{0, 1 - \xi_{FDIt}\}$. Now $\xi_{1t} > 0$, because otherwise labor in Economy 1 would not be employed, making additional production possible, so the only boundary case is $\xi_{1t} = 1 - \xi_{FDIt}$, when all labor in Economy 2 is employed in the FDI sector. In this case employment in domestic production in Economy 2 is not competitive with employment in FDI sectors, so there is no domestic supply and there is no price $p_{2t}$. Without loss of generality we can set $p_{2t} = p_{1t}$. Now similarly $p_{FDIt}$ cannot be more than $p_{1t}$, otherwise FDI sectors would loose their markets to domestic sectors in Economy 1. On the other hand, the competitive fringe for FDI sectors is in Economy 1, so $p_{FDIt}$ will be at least $p_{1t}$. Hence $p_{FDIt} = p_{1t}$. It follows that all prices $p_{1t}, p_{2t}, p_{FDIt}$ are equal. We therefore set them as numeraire,

$p_{1t} = p_{2t} = p_{FDIt} = 1$.

Since expenditure is constant across sectors, it now also follows that production quantities are equal, and equal to expenditure:

$y_{1t} = y_{2t} = y_{FDIt} = y_{it}$.

Since $\xi_{it}y_{it} = Y_{it}$, and sector measures add up to one (2.1), (2.10) follows. \(\square\)

\(^2\)If the price of FDI products where proportional to $A_{2t}$, the level of production would become large as $A_{2t}/A_{1t} \to 0$ (the case of divergent equilibria, see below) something that seems unrealistic. Intermediate cases with less than full profits could be posed leading to similar results.

\(^3\)Note if all sectors are involved in FDI then wages are not fully defined domestically, and neither is the home technological level. We will assume below that home knowledge does continue to exist and follows the same dynamics, although other analyzes are possible.
Corollary 1. Suppose that $r_{FDIt} = r_{2t} = r_{1t}$. Profits and sector participations are

\[ \Pi_{it} = \left( 1 - \frac{1}{\chi} \right) Y_{it}, \quad i \in \{1, 2\}; \quad \Pi_{FDIt} = \left( 1 - \frac{b_{FDIt}}{\chi} \right) Y_{FDIt}, \]

\[ r_{it}K_{it} = \frac{\alpha}{\chi} Y_{it}, \quad w_{it}L_{it} = \frac{1 - \alpha}{\chi} Y_{it}, \quad i \in \{1, 2\}, \]

\[ r_{FDIt}K_{FDIt} = \frac{ab_{FDIt}}{\chi} Y_{FDIt}, \quad w_{FDIt}L_{FDIt} = \frac{(1 - \alpha)b_{FDIt}}{\chi} Y_{FDIt}. \]

We now find the assignment of production in terms of the state variables.

Remark 1. The labor market clearing conditions, setting demand equal to supply, are:

\[ \xi_{1t}l_{1t} = L_{1t} = \mathcal{L}_{1t}, \]

\[ \xi_{2t}l_{2t} + \xi_{FDIt}l_{FDIt} = L_{2t} + L_{FDIt} = \mathcal{L}_{2t}. \]

These two equations complete the instantaneous description of the economy.

Theorem 1. The sectorial measures $\xi_{FDIt}$, $\xi_{1t}$, $\xi_{2t}$ are given by

\[ \xi_{it} = \frac{r_{it}K_{it}}{r_{it}K_{it} + r_{2it}K_{2it} + \frac{1}{b_{FDIt}} r_{FDIt}K_{FDIt}}, \quad i \in \{1, 2\}, \]

\[ \xi_{FDIt} = \frac{1}{b_{FDIt}} \frac{r_{FDIt}K_{FDIt}}{r_{it}K_{it} + r_{2it}K_{2it} + \frac{1}{b_{FDIt}} r_{FDIt}K_{FDIt}}. \]

In the case of perfect capital mobility $r_{FDIt} = r_{2t} = r_{1t}$, we obtain the following results

\[ \frac{L_{2t}}{L_{FDIt}} = \frac{K_{2t}}{K_{FDIt}}, \]

so

\[ L_{2t} = \frac{K_{2t}L_{2t}}{K_{2t} + K_{FDIt}}, \quad L_{FDIt} = \frac{K_{FDIt}L_{2t}}{K_{2t} + K_{FDIt}}, \]

\[ \Lambda_{it}K_{it} = K_{2t} + K_{FDIt}, \]

where

\[ \Lambda_{t} = q^{2}\lambda_{1}. \]

The sectorial measures $\xi_{FDIt}$, $\xi_{1t}$, $\xi_{2t}$ can be reduced to

\[ \xi_{1t} = \frac{1}{1 + q^{3}a_{t}\lambda_{t}L_{2t} + q^{3}a_{t}^{1-(1-\alpha)(1-\beta)}L_{FDIt}}, \]

\[ \xi_{2t} = \frac{q^{2}a_{t}\lambda_{t}L_{2t}}{1 + q^{3}a_{t}\lambda_{t}L_{2t} + q^{3}a_{t}^{1-(1-\alpha)(1-\beta)}L_{FDIt}}, \]

\[ \xi_{FDIt} = \frac{q^{3}a_{t}^{1-(1-\alpha)(1-\beta)}L_{FDIt}}{1 + q^{3}a_{t}\lambda_{t}L_{2t} + q^{3}a_{t}^{1-(1-\alpha)(1-\beta)}L_{FDIt}}. \]

Proof. (2.16) and (2.17) follow from equations (2.10), (2.12), (2.13). According to the last two, the interest rates $r_{FDIt} = r_{2t} = r_{1t}$ iff

\[ \frac{ab_{FDIt}}{\chi} \left( \frac{B_{FDIt}L_{FDIt}}{K_{FDIt}} \right)^{1-\alpha} = \frac{\alpha}{\chi} \left( \frac{B_{2t}L_{2t}}{K_{2t}} \right)^{1-\alpha} = \frac{\alpha}{\chi} \left( \frac{B_{1t}L_{1t}}{K_{1t}} \right)^{1-\alpha}. \]
From the first equation

\[(2.26) \quad \frac{L_{2t}}{L_{FDIt}} = \frac{b_{FDIt} (B_{FDIt} K_{2t})}{B_{FDIt} K_{FDIt}} = \frac{K_{2t}}{K_{FDIt}}.\]

It follows that

\[(2.27) \quad L_{2t} = \frac{K_{2t} L_{2t}}{K_{2t} + K_{FDIt}}, \quad L_{FDIt} = \frac{K_{FDIt} L_{2t}}{K_{2t} + K_{FDIt}}.\]

From the second equation in (2.25)

\[(2.28) \quad q^\beta a_t L_{2t} = \frac{K_{2t} L_{2t}}{K_{1t}}.\]

From equations (2.16), (2.17)

\[
\xi_{1t} = 1 + \frac{1}{b_{FDIt} K_{1t}} \int_{0}^{1} \ln (k_{1t}(\eta)) d\eta.
\]

and similarly with \(\xi_{2t}, \xi_{FDIt}\). \(\Box\)

2.3. Capital accumulation. Recall we defined in equation (2.9) a subutility function \(C_t\) for consumption. Using the same kernel, we define capital as a good which results from the combination of a quantity \(k_t(\eta)\) of goods in all sectors, yielding an amount \(K_t\) of capital according to:

\[(2.29) \quad \ln (K_t) = \int_{0}^{1} \ln (k_t(\eta)) d\eta.\]

When a firm invests, it maximizes (2.29) just as the consumer maximizes (2.9), demanding the same expenditure on each good. Therefore the composition of demand remains unaltered. As we have seen, all prices are equal and therefore the quantities of capital inputs \(k_t(\eta)\) demanded are also equal. Since prices are 1, a unit of capital is obtained by purchasing and combining a unit of each sector’s good, at a unit cost, because

\[
\ln (1) = \int_{0}^{1} \ln (1) d\eta, \quad \int_{0}^{1} p_t(\eta) k_t(\eta) d\eta = \int_{0}^{1} 1 \times 1 d\eta = 1.
\]

In Appendix 5.1 we show that optimization by myopic agents generates the standard savings assumption of the Solow model. Now, we would ideally prefer to think of a situation where savings out of profits might be higher than savings out of labor. This would entail using more complex instantaneous utility functions in which consumption and savings decision might depend on income and might also be different between consumers and firms, and therefore keeping tab of income levels and income distributions, as well as property.

Instead, for we simply assume that, on average, a fixed proportion \(s^Y\) of aggregate world income \(Y^W_t = Y_{1t} + Y_{2t} + Y_{FDIt}\), and a fixed additional proportion \(s^\Pi \geq 0\) is saved on profits above and beyond labor and capital participation. Hence
FDI, POLARIZED GLOBALIZATION, AND THE CURRENT CRISIS

we obtain a Solow model for capital,

\[ \dot{K}_t = S_t^W - \delta K_t \]

(2.30) \[ = s Y_t^W + s^H \left( 1 - \frac{1}{\chi} \right) (Y_1 + Y_2) + s^H \left( 1 - \frac{b_{FDI}}{\chi} \right) Y_{FDIt} - \delta K_t, \]

(2.31) \[ = SY_t^W + s^H \left( 1 - \frac{b_{FDI}}{\chi} \right) Y_{FDIt} - \delta K_t, \]

with \( S_t^W \) representing aggregate world savings, where \( S = s Y + s^H \left( 1 - \frac{1}{\chi} \right) \).

The competitive fringe has an additional role in this model. It can produce for self-subsistence. This means that it sets minimum reference rates of interest and wages in both domestic sectors. We assume there are perfect financial markets so that \( r_{FDIt} = r_2 = r_{1t} \).

On the other hand, technology owners will draw financial resources to the most profitable investments. When \( \alpha_t < 1, \xi_{2t} > 0, \) and \( \xi_{FDI} < \xi_{FDI} \), it is possible to invest in expanding the measure of FDI sectors and this will be the most profitable venture. All capital resources will be directed to this end. A negotiation problem may come up between capital suppliers for the allocation of the profits, but since the saving rate on profits is constant, this makes no difference to the dynamics of the model.

Under autarky, capital accumulation is given by

\[ \dot{K}_{jt} = SK_{jt}^\alpha (B_{jt} L_{jt})^{1-\alpha} - \delta K_{jt}, \quad j = 1, 2, \]

where we assume both economies have the same depreciation rate \( \delta \), and the savings rate is \( S = s Y + s^H \left( 1 - \frac{1}{\chi} \right) \). Suppose the population growth rates are \( n_{jt} \), and for the moment suppose that \( B_{jt} \) have growth rates \( g_j \). Steady state interest rates under autarky would be

(2.32) \[ r^*_{jt} = \alpha \left( \frac{\delta + n_{jt} + g_j}{s_j} \right)^{\frac{1}{\alpha}}. \]

If \( s_2 \leq s_1 \) or \( n_2 \geq n_1 \), it follows that \( r^*_2 \geq r^*_1 \).

2.4. **Technological change.** In Appendix 5.2 we model technological change under infinitesimal foresight and show that in a quality ladder model FDI innovators have less incentives for innovation than domestic producers. The reason is that in this type of model innovation is equivalent to reducing costs, and FDI producers face lower costs.

2.4.1. **Technological change in the two economies.** We have shown that innovators with infinitesimal foresight choose a rate of technological change which is a function of their profits. While FDI producers may have different innovation incentives than domestic producers, world profits are so large that we prefer to ignore these effects. Thus we simplify technological change in Economy 1 to

(2.33) \[ \dot{A}_{1t} = \gamma_1. \]

In the case of Economy 2, the scale effect due to market size is even larger than for Economic 1, so we also assume its marginal impact is negligible. The nature of technological change in Economy 2 can give rise to multiple steady states for various reasons. We will consider three specifications that imply the existence
of underdevelopment as a lower steady state. The first is simply a difference in institutional levels \( q_2 \). The second assumes that the relative number of sectors \( \xi_{1t} \) generate a relative level of research externalities \( (\xi_{1t})^\kappa \) between Economy 1 and Economy 2. The third assumes that the population growth rate \( \frac{n}{a_t} \) is endogenous and tied, together with human capital, to the relative technological level \( a_t \). Hence we let

\[
\frac{\dot{A}_{2t}}{A_{2t}} = g_2(\cdot) + \theta_{\text{FDI}}^{\text{weak}} + \theta_{\text{FDI}}^{\text{strong}} a_t^{-1},
\]

with

\[
g_2(\cdot) = \begin{cases} 
q\gamma_1 + \mu(1 - a_t) & \text{only institutional differences,} \\
q\gamma_1 + \mu(1 - a_t) \left( \frac{\xi_{1t}}{\xi_{2t}} \right)^\kappa & \text{sector externalities, } \kappa > 0, \\
q\gamma_1 + \mu(1 - a_t) \cdot \text{endogenous pop. growth.} 
\end{cases}
\]

Note that \( \mu(1 - a_t) \) is a convergence term proportional to the distance to the leading technological edge. \( \mu \) represents the ease at which ideas flow between economies. \( q\gamma_1 \) is the growth rate resulting from the institutional arrangements of Economy 2, when there is no technological lag. Under autarky the reference growth rate corresponds to \( \frac{\xi_{2t}}{\xi_{1t}} = 1 \), so the second specification reverts to the first. Note that population growth rates are assumed to be equal in the first two cases.

In the third case, fertility is endogenous and simultaneously determined with human capital. We assume the rate of convergence is proportional to the relative human capital level \( h_{a_t} \) and that the population growth rate is \( n(a_t) \) with \( \lim_{a_t \to 0} n(a_t) = n^{\text{high}} \) and \( n(a_t) = n_1 \) for \( a_t > a_{\text{crit}} \).

We allow in \( (2.34) \) for an impact of FDI on technological change in the host economy, operating through strong and weak externalities, according to whether they are proportional to \( A_{1t} \) (and therefore to the production flow produced by FDI) or to \( A_{2t} \).

2.4.2. Technological steady states. We turn to the equations of technological change. It follows from equations \((2.22), (2.23), (2.24)\) that

\[
\frac{\xi_{2t}}{\xi_{1t}} = q^\beta a_t \lambda_t \frac{L_{2t}}{L_{2t}} = \frac{q^\beta a_t \lambda_t K_{2t}}{K_{2t} + K_{\text{FDI}t}}.
\]

Hence, technological change takes one of the three forms

\[
\frac{\dot{a}_t}{a_t} = H(a_t) \equiv \begin{cases} 
(q - 1) \gamma_1 + \mu(1 - a_t) & \text{only institutional differences,} \\
(q - 1) \gamma_1 + \mu(1 - a_t) \left( \frac{\xi_{1t}}{\xi_{2t}} \right)^\kappa & \text{sector externalities, } \kappa > 0, \\
(q - 1) \gamma_1 + \mu(1 - a_t) \cdot \text{endogenous pop. growth.} 
\end{cases}
\]

This kind of dynamical system has two kinds of steady states \( a^* \). If \( a^* > 0 \), the two economies’ technologies will differ only in levels over the long term. We call this divergence in levels, unless \( a^* = 1 \). If \( a^* = 0 \), the technologies will differ in growth rates, the difference given by the right hand side. If \( a^* \) grows beyond 1, Economy 2 overtakes Economy 1.

**Theorem 2.** Technological steady states under globalization.

1. Strong FDI externalities. Suppose \( \theta_{\text{FDI}}^{\text{strong}} > 0 \). In this case divergence in growth rates is not possible. Moreover if \( \theta_{\text{FDI}}^{\text{strong}} \) is large enough, Economy 2 overtakes Economy 1.
Since this result is unrealistic, we assume for the remainder of the theorem that \( \theta^{FDI}_{strong} = 0 \).

(2) Institutional differences. In this case

\[
\frac{\dot{a}_t}{a_t} = H(a_t) \equiv (q-1) \gamma_1 + \mu (1-a_t) + \theta^{FDI}_{weak}.
\]

If \((q-1) \gamma_1 + \theta^{FDI}_{weak} > 0\) then Economy 2 overtakes Economy 1. If \(0 \leq (q-1) \gamma_1 + \mu + \theta^{FDI}_{weak} \leq \mu\), there is a single steady state given by

\[
a^* = \frac{(q-1) \gamma_1 + \mu + \theta^{FDI}_{weak}}{\mu} \geq 0.
\]

If \((q-1) \gamma_1 + \mu + \theta^{FDI}_{weak} < 0\), there is divergence in growth rates.

(3) Sector externalities in innovation. In this case,

\[
\frac{\dot{a}_t}{a_t} = (q-1) \gamma_1 + \mu (1-a_t) \left( \frac{q^\beta a_t \lambda K_{2t}}{K_{2t} + K_{FDIt}} \right)^\kappa + \theta^{FDI}_{weak}.
\]

If \((q-1) \gamma_1 + \theta^{FDI}_{weak} \geq 0\) then Economy 2 catches up or overtakes Economy 1. If instead \((q-1) \gamma_1 + \theta^{FDI}_{weak} < 0\), there are two possibilities. If FDI undergoes sectorial expansion long enough for \(\xi_{FDIt}\) to become large enough, \(a^* = 0\) will be the only steady state. Otherwise Economy 2 can diverge in growth rates, diverge in levels, or overtake Economy 1. If \(\xi_{2t} < \xi_{1t}\), the steady state \(a^*\) is lower than under autarky.

(4) Endogenous fertility. In this case

\[
\frac{\dot{a}_t}{a_t} = (q-1) \gamma_1 + \mu (1-a_t) h a_t + \theta^{FDI}_{weak}.
\]

If \(\theta^{FDI}_{weak} - (q-1) \gamma_1 \geq 0\) then Economy 2 catches up or overtakes Economy 1. If instead \(\theta^{FDI}_{weak} - (q-1) \gamma_1 < 0\), Economy 2 can diverge in growth rates, diverge in levels, or overtake Economy 1.

Proof. (1) If \(\theta^{FDI}_{strong} > 0\), \(\lim_{a_t \to 0} H(a_t) = \infty\), so divergence in growth rates is impossible. If \(\theta^{FDI}_{strong}\) is large enough, \(H(a_t)\) may be positive for \(0 \leq a_t \leq 1\), in which case Economy 2 overtakes Economy 1.

(2) The proof is direct.

(3) If \(\theta^{FDI}_{weak} - (q-1) \gamma_1 \geq 0\), \(H(a_t) > 0\) for \(0 \leq a_t < 1\). If instead \(\theta^{FDI}_{weak} - (q-1) \gamma_1 < 0\), \(\frac{\dot{a}_t}{a_t}\) has a maximum value

\[
(q-1) \gamma_1 + \frac{\mu \kappa}{(\kappa+1)^{\kappa+1}} \left( \frac{q^\beta \lambda K_{2t}}{K_{2t} + K_{FDIt}} \right)^\kappa + \theta^{FDI}_{weak},
\]

which is negative if \(\frac{K_{2t}}{K_{2t} + K_{FDIt}}\) is small enough. Note that in equation (2.24) \(\frac{\partial \xi_{FDIt}}{\partial a_t}\) is positive, and \(\frac{K_{2t}}{K_{2t} + K_{FDIt}} = 1 - \frac{\xi_{FDIt}}{\xi_{2t}}\). If \(\xi_{FDIt}\) is small enough \(H(a_t) = 0\) has two positive roots yielding the result.

(4) Again, for \(h > 4\left(1-q\right) \gamma_1 - \theta^{FDI}_{weak} > 0\), \(H(a_t) = 0\) has two positive roots. When \(a_t \to 0\), \(\frac{\dot{a}_t}{a_t} \to (q-1) \gamma_1 + \theta^{FDI}_{weak}\). \(\square\)

The theorem shows that institutional differences, sectoral externalities, and endogenous fertility can all give rise to underdevelopment under globalization. The last two types of dynamics admit multiple technological steady states for economies with the same parameters. Underdevelopment falls into two types, divergence in
growth rates or in levels. Miracle growth is also possible, when some set of policy changes shifts an economy from one attractor to a higher one, or raises the level of an attractor.

2.5. **Transitional investment dynamics.** We assume for simplicity that \( r_{FDIt} = r_{2t} = r_{1t} \). Under these conditions, when FDI sectorial expansion is possible it becomes the priority investment. More complex transitional dynamics implying prioritization between investments in the domestic sectors of Economies 1 and 2 are possible under less restrictive conditions.

2.5.1. **FDI sectorial expansion.** We say FDI is undergoing sectorial expansion if \( \xi_{FDIt} \) is increasing. We show that there are always incentives for FDI sectorial expansion at the expense of the domestic sector of Economy 2. Given a total investment \( I_t \) at time \( t \),

\[
\dot{K}_{1t} + \dot{K}_{2t} + \dot{K}_{FDIt} = I_t - \delta K_{1t} - \delta K_{2t} - \delta K_{FDIt}.
\]

The time derivative of equation (2.20) is

\[
\dot{\Lambda}_t K_{1t} + \Lambda_t \dot{K}_{1t} = \dot{K}_{2t} + \dot{K}_{FDIt}.
\]

from these two equations we obtain

\[
\dot{K}_{1t} = \frac{I_t - \Lambda_t K_{1t} - \delta K_{1t} - \delta K_{2t} - \delta K_{FDIt}}{1 + \Lambda_t},
\]

\[
\dot{K}_{FDIt} = \frac{\dot{\Lambda}_t K_{1t} - \dot{K}_{2t} (1 + \Lambda_t) + \Lambda_t (I_t - \delta K_{1t} - \delta K_{2t} - \delta K_{FDIt})}{1 + \Lambda_t}.
\]

Note that \( \dot{K}_{1t} \) is independent of \( \dot{K}_{2t} \), while \( \dot{K}_{FDIt} \) is decreasing in \( \dot{K}_{2t} \). This shows that FDI sectorial expansion takes place at the expense of \( K_{2t} \). FDI investment is maximized when no investment takes place in \( K_{2t} \), which we assume means \( \dot{K}_{2t} = -\delta K_{2t} \).

Summarizing,

**Proposition 3.** Under perfect capital markets, the transition to a steady state has two phases. In the first, capital investment prioritizes FDI at the expense of the domestic sector of Economy 2, while investment in the domestic sectors of Economy 1 are driven by interest rate equalization. In the second, FDI is restricted by the condition \( \xi_{FDIt} = \bar{\xi}_{FDI} \), giving rise to balanced or divergent growth between the three types of sectors, following the technological dynamics.

2.5.2. **Steady state capital dynamics.** We turn to the capital steady states, which depend on FDI sectorial expansion being bounded. Note that

\[
\xi_{2t} = 0 \iff q^\beta a_t \lambda_t \frac{L_{2t}}{K_{2t}} = 0
\]

\[
0 = q^\beta a_t \lambda_t \frac{K_{2t}}{K_{2t} + K_{FDIt}} = \frac{K_{2t}}{K_{1t}}
\]

\[
K_{2t} = 0.
\]

Since FDI sectorial expansion is always preferable to other investment, \( \xi_{2t} \) will only remain bounded away from 0 if FDI is restricted to \( \xi_{FDIt} = \bar{\xi}_{FDI} \).
From (2.31), (2.5), using $Y_t^W = y_t$, $Y_{FDIt} = \xi_{FDIt}y_t$, the savings rate is

$$s(a_t, \xi_{FDIt}) = S + \xi_{FDIt}q^\beta \left(1 - a_t^{(1-\alpha)(1-\beta)}\right).$$

We now state how capital is distributed at the different technological steady states. Observe that the steady state interest rate under globalization is lower than under autarky.

**Theorem 3. Capital Growth Paths.**

(1) Suppose that $n_1 = n_2$, so $\lambda$ is constant, that $a^* > 0$ and that $\xi_{FDIt}$ converges to $\xi_{FDI}$. Then $K_{1t}$, $K_{2t}$, $K_{FDIt}$ tend to parallel growth, with

$$\lim_{t \to \infty} \frac{K_{2t} + K_{FDIt}}{K_{1t}} = q^\beta a^*, \quad \lim_{t \to \infty} \frac{K_{FDIt}}{K_{2t} + K_{FDIt}} = \lim_{t \to \infty} \frac{L_{FDIt}}{L_{2t}} = q^\beta \frac{a^* \Lambda a^{(1+(1-\alpha)(1-\beta))} \xi_{FDI}}{(1 + q^\beta a^* \Lambda) (1 - \xi_{FDI} + a^* (1-\alpha)(1-\beta) \xi_{FDI})}.$$  

The savings rate converges to $s(a^*, \xi_{FDI}) > S$. Since the technological level in both economies grows at the same rate $\gamma_1$ as Economy 1 does in autarky, the equilibrium interest rate with FDI is lower than Economy 1’s in autarky. Note by Theorem 2.3 that $\xi_{FDI}$ must be large enough for $a^* > 0$ to be possible.

(2) If instead we have endogenous fertility, with $a^* > 0$, $n(a^*) > n_1$, and therefore $\lambda_t \to \infty$,

$$\lim_{t \to \infty} K_{2t} = \infty,$$

$$\lim_{t \to \infty} \frac{K_{FDIt}}{K_{2t} + K_{FDIt}} = \lim_{t \to \infty} \frac{L_{FDIt}}{L_{2t}} = q^\beta \frac{a^* \Lambda a^{(1+(1-\alpha)(1-\beta))} \xi_{FDI}}{(1 + q^\beta a^* \Lambda) (1 - \xi_{FDI} + a^* (1-\alpha)(1-\beta) \xi_{FDI})}.$$  

This means that as Economy 2’s population grows, its capital investment relative to Economy 1 becomes large in proportion to $\lambda$. However, it continues to lag technologically, continues to grow in population, and its domestic sector is very inefficient.

(3) In the case $a^* = 0$ and $\lambda$ constant, $\xi_1^* = 1$, $\xi_2^* = 0$, $\xi_{FDI}^* = 0$, by (2.22), and

$$\lim_{t \to \infty} \frac{K_{2t} + K_{FDIt}}{K_{1t}} = 0, \quad \lim_{t \to \infty} \frac{K_{FDIt}}{K_{2t} + K_{FDIt}} = 0.$$

(4) If instead we have endogenous fertility, with $a^* = 0$, $n(0) > n_1$, and therefore $\lambda_t \to \infty$, let

$$\Lambda = \lim_{t \to \infty} q^\beta a_t^\lambda, \quad \Omega = \lim_{t \to \infty} q^\beta a_t^{1+(1-\alpha)(1-\beta)} \lambda_t,$$

where $\Lambda \geq \Omega$ may be zero, positive or infinity. In every case $\lim_{t \to \infty} \frac{K_{FDIt}}{K_{2t} + K_{FDIt}} = 0$ and $\xi_{FDI}^* = 0$. Additionally the following cases arise:

(a) $\lim_{t \to \infty} \frac{K_{2t} + K_{FDIt}}{K_{2t}} = 0$, $\xi_1^* = 1, \xi_2^* = 0$, if $\Lambda = \Omega = 0$,
(b) $\lim_{t \to \infty} \frac{K_{2t} + K_{FDIt}}{K_{2t}} = \Lambda$, $\xi_1^* = \frac{1}{1+\Lambda}, \xi_2^* = \frac{\Lambda}{1+\Lambda}$, if $\Lambda > \Omega > 0$,
(c) $\lim_{t \to \infty} \frac{K_{2t} + K_{FDIt}}{K_{2t}} = \infty$, $\xi_1^* = 0, \xi_2^* = 1$, if $\infty = \Lambda \geq \Omega > 0$.

**Proof.** The proof is straightforward, using the identity (2.51).
Analogously to Galor and Mountford (2008), the theorem shows that polarized technological change promoted by globalization can generate an unsustainable population growth trap.

3. Governance issues

While globalization raises huge capital flows originating from FDI sectors that raise the productivity of workers in underdeveloped economies, these additional resources are concentrated in profits that leave the host economies, and do not necessarily promote domestic investment or development, neither in advanced nor in lagging economies.

Transnational corporations raise a host of governance problems, since the main motors of capital accumulation now lie beyond the reach of national governments. Given that taxes lie at the origin of governance, and that transnational corporations find it easier to avoid taxes, Mayer-Foulkes (2009a) proposes a harmonization of taxes on domestic and FDI production to 1) promote governance and cooperation, 2) fund development in both types of economies, 3) slow globalization to make the necessary economic transitions easier for workers in both types of economies, and 4) stabilize the financial system by raising the interest rate.

The increased government funding would also make the shift from FDI expansion to simultaneous domestic and FDI growth easier. This shift may already be taking place or may take place later. In any case it is in the political interest of corporations to promote the expansion of FDI, in a sequential process that can generate large qualitative investment shifts and therefore volatility in the globalization transition.

A harmonized taxation initiative would also strengthen government finances, something that is much needed now.

A corollary of the previous theorem is the following.

**Corollary 2.** *Taxes levied on extraordinary FDI profits increase the interest rate, thereby making the financial system more stable, directly by reducing the savings rate and indirectly if these taxes are used to raise the rate of innovation. They can also be used to raise α*. 

Further illustrating the governance challenge, in another interpretation of the model all economies are Economy 2, and technological change is conducted by corporations. These live outside the governance of all economies. They concentrate huge wealth which lies beyond all domestic consumption. Their power would be directed to maintaining low wages in many countries and to concentrate technological change where it is most economical, free riding on the necessary human capital.

Polarized globalization originates in the separate knowledge systems of each economy. True balanced global development depends on bridging these technological differences. Policies specifically directed to transferring technology to the poor and poor regions, which should also raise the incentives for human capital accumulation, thereby decreasing fertility, are essential for sustainable development. The fact that globalization does not currently sufficiently promote either technology transfer or the demographic transition is corroborated by Mayer-Foulkes (2012).
4. Conclusions

When liberalization occurs between developed and underdeveloped economies, FDI produces extraordinary profit flows that contribute to inequality within and between economies. It also generates steady states characterized by polarization that are consistent with development, underdevelopment, and miracle growth. This occurs for example when the rate of technological adoption and innovation are characterized by any of the following:

1. Institutional quality. This can range from property rights to determinants of human capital accumulation, infrastructure provision, as well as other government provided services.
2. Sectorial externalities making the cost of innovation in each economy dependent on its aggregate sectorial allocation of production.
3. Human capital levels determined by endogenous fertility decisions that imply a correlation between technological backwardness and low levels of human capital investment, and high levels of population growth.

FDI investment, and therefore the globalization transition, occurs in two phases. In the first, new sectors open up for FDI, and FDI expansion becomes the priority investment. In the second, when FDI becomes restricted to capital deepening, domestic sectors grow more.

While FDI creates more wealth, it does not necessarily lead to more development, because the new wealth is transferred to innovators in developed economies. Under sectorial externalities, the technological steady state achieved by the lagging economy is lower under globalization than under autarky. In the other two cases the steady states are the same under autarky as under globalization, and the world growth rate does not depend on globalization.

Globalization presents huge challenges for global governance. These originate in the huge profit flows obtained by corporations in a transnational context, that generates political and economic power that is not subject to the traditional checks and balances. The importance of these issues is illustrated by the sustainability challenge posed by polarized population growth.

5. Appendix

5.1. Myopic saving. Suppose that agents are myopic and decide on consumption and saving each instant according to the utility function

\[ U_t = C_t^{1-\sigma} S_t^\sigma. \]

The utility function describes myopic agents with a preference for saving for the future. This utility function can be derived as the continuous analogous of the altruistic utility function \( U_t = c_t^{1-\sigma} b_t^\sigma \) often used in discrete intergenerational models, where \( c_t \) is consumption and \( b_t \) an intergenerational bequest. When \( U_t \) is maximized subject to an income \( Y_t \), agents consume and save according to:

\[ C_t = (1 - \sigma) Y_t, \quad S_t = \sigma Y_t, \]

and therefore \( \sigma \) is the saving rate.
5.2. Innovation under infinitesimal foresight. We model technological change under infinitesimal foresight, because this yields a Solow-style model. We assume that innovation is cheaper for the producing incumbent than for the competitive fringe, who therefore has an innovation advantage both in autarky and under trade.

Over a time period $\Delta t$, the incumbent can invest $s_t \Delta t$ units of resources in R&D (or technological absorption) to obtain a technological level

$$A_{jt+\Delta t} = A_{jt} \left(1 + g_j (a_t, \varsigma_j, q_j) R \left(\frac{s_t}{A_{jt}}\right) \Delta t\right),$$

where $R$ is a bounded innovation function that is increasing in $\frac{s_t}{A_{jt}}$ and has decreasing returns tending eventually to zero, satisfying $R(0) = 0$, $R'(s_t) > 0$, $R''(s_t) < 0$ for $s_t \geq 0$. We take for example $R(s) = 1 - \exp(-\gamma s)$. Division of $s_t$ by $A_{jt}$ represents the shrinking out effect. $g_j (a_t, \varsigma_j, q_j)$ represents externalities impacting innovation. Due to the flow of ideas from Economy 1 to Economy 2, which is increasing in the technology gap, $\frac{\partial g_2}{\partial a_t} < 0$. We assume $g_1 (1, \varsigma, q) = g_2 (1, \varsigma, q)$, that is, the innovation functions of leader and follower are identical if they are at the same technological level, innovate for the same number of sectors, and have the same institutional quality. This is the traditional convergence effect (Gerschenkron, 1952).

Conversely, because technology improvements in Economy 2 can also impact Economy 1, especially once convergence is approached, $\frac{\partial g_1}{\partial a_t} > 0$. There are also positive externalities from research conducted in the same economy, measured by

$$(5.1) \quad \varsigma_1 = \xi_1 + \xi_{FDI}, \quad \varsigma_2 = \xi_2.$$  

What this means is that research may be significantly easier where other research of the same level is being conducted. For example, fixed costs in higher education may be shared, and related techniques for solving related problems may be employed. Finally, institutional quality itself has a positive impact on innovation.

Consider first an incumbent in Economy 1 that is not subject to competition. Because costs will be inversely proportional to $A_{jt}^{1-\alpha}$, her profit flow at time $t + \Delta t$ is:

$$\Pi_{t+\Delta t} (s_t) = \left[1 - \frac{B}{\chi \left(1 + g_j (a_t, \varsigma_j, q_j) R \left(\frac{s_t}{A_{jt}}\right) \Delta t\right)}\right]^{1-\alpha} y_t - s_t \Delta t$$

According to expressions (2.11) for profits, $B$ is 1 for domestic producers and $b_{FDIt}$ for FDI producers.

**Proposition 4.** We say an innovator has infinitesimal foresight if she maximizes profit flow $\Pi_{t+\Delta t} (s_t)$. This profit flow has a unique maximum at some optimal investment rate $s^* (B, a_t, \varsigma_j, q_j, A_{jt})$ which is increasing in cost factor $B$. This investment rate corresponds to an innovation rate

$$\max \left(0, g_j (a_t, \varsigma_j, q_j) - \frac{h (B) A_{jt}}{(1 - \alpha) \gamma y_t}\right),$$

where $h (B) = \chi \left[1 - \frac{B}{\chi}\right]^{\alpha} / B$.  


Proof. Observe that the first order condition for maximization is

\[
\Pi_t' + \Delta t(s_t) = \left[ 1 - \frac{B}{\chi \left( 1 + g_j(a_t, \varsigma_j, q_j) R \left( \frac{A_j t}{A_j t} \Delta t \right) \right)} \right]^{-\alpha} \\
\frac{(1 - \alpha) B y_t g_j(a_t, \varsigma_j, q_j) R' \left( \frac{A_j t}{A_j t} \Delta t \right)}{\chi A_j t \left( 1 + g_j(a_t, \varsigma_j, q_j) R \left( \frac{A_j t}{A_j t} \Delta t \right) \right) - \Delta t} \leq 0,
\]

with equality occurring only if \( s_t = 0 \). Taking the limit as \( \Delta t \to 0 \), an interior maximum profit flow occurs when

\[
\frac{(1 - \alpha) B y_t g_j(a_t, \varsigma_j, q_j) R' \left( \frac{A_j t}{A_j t} \Delta t \right)}{\chi A_j t \left[ 1 - \frac{B}{\chi} \right]^{\alpha}} = 1,
\]

\[
R' \left( \frac{s_t}{A_j t} \right) = \frac{A_j t h(B)}{(1 - \alpha) y_t g_j(a_t, \varsigma_j, q_j)}.
\]

In the case of our example, \( R'(s) = \gamma \exp(-\gamma s) \) so

\[
\frac{s_t}{A_j t} = \max \left( 0, \ln \left( \frac{(1 - \alpha) \gamma y_t h(B) A_j t}{g_j(a_t, \varsigma_j, q_j)} \frac{1}{\gamma} \right) \right).
\]

Observe that the first fraction is increasing in \( B \). The second fraction implies backward countries invest proportionally more if externalities due to \( \varsigma_j \) are not strong. Recall that the number of sectors an economy innovates in depends on its technological level.

Corollary 3. FDI innovators have less incentives to innovate than domestic innovators.

Proof. Cost factor \( B \) for domestic innovators is 1, which is larger than \( b_{FDI t} = a_t^{(1 - \beta)(1 - \alpha)} < 1 \), the FDI producers’ cost factor.

This conclusion, which follows under very general conditions, is remarkable. In a quality ladder context, even though FDI producers have higher profits, they have lower innovation incentives, since they face lower costs. Of course, FDI producers might have some incentives to innovate to adapt their production to unskilled labor, to transportation, and so on. A different conclusion could hold in a variety context.

6. References


