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Technological Innovation, Entrepreneurship and Development

David B. Audretsch and Mark Sanders

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Abstract

Industrialization has long been seen as the answer to underdevelopment and poverty. First this led countries to follow protectionist import substitution policies but as these failed developing countries have opened up to trade and FDI and tried to follow strategies of export driven industrialization. If we consider the share of non-OECD countries in global trade in manufactures, this has been a big success. But has it? Developed countries still retain their competitive advantage in the innovative and fast growing industries of the future and for every success story in Asia there are at least two tales of woo in Africa. In this paper we present a two region product life cycle model of global specialization and trade. In it we analyse the impact of three major shocks to the gradually globalizing and integrating world economy and show that these shocks have caused a transition in the global specialization pattern. The advanced and previously industrialized countries have arguable made the transition to an entrepreneurial economy in which innovation, creativity and high value added in early stage activity are the basis of competitive advantage, whereas the developing world by-and-large has absorbed mature industrial activities based on the Heckscher–Ohlinian competitive advantage based on cheap unskilled labour. The key exogenous shocks that have led to this shift are the collapse of communism, the introduction of information and communication technologies and the opening up of large, populous developing countries such as India, China, and Brazil. Our model predictions are very much in line with observed trends in developing and developed economies and as such provides insights in the possible underlying mechanisms at work.

Keywords: globalization, innovation, trade, development
JEL Codes: F01, J31, O1, P0

* Max Planck Institute of Economics, Research Group on Entrepreneurship, Economic Growth and Public Policy, Jena, Germany. Email of corresponding author: m.w.j.l.sanders@uu.nl

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Abbreviations

CES	Constant Elasticity of Substitution
FDI	Foreign direct investment
ICT	Information and communication technology
GFCF	Gross fixed capital formation
GPT	General purpose technology
OECD	Organisation for Economic Cooperation and Development
R&D	Research and development

1 Introduction

Globalization and technical change have been identified as key sources of structural change in industrialized and developing countries alike (e.g. Grossman and Helpman 1991; Helpman 1998). At the same time both trends can be understood as the outcome of economic processes rather than exogenous to the global economic system. That begs the question what fundamental economic mechanisms may underlie the interaction between globalization, technical innovation, and structural change. The purpose of this paper is to address that question. We do so by analysing the impact of three important shocks to the global economy that have occurred since the 1980s.

Arguably, the fall of communism in essence caused an exogenous global reduction in political risks and allowed large low skilled labour abundant economies to join the global economy (Audretsch 2007). This opening up of opportunities for economic integration coincided with the, also exogenous, introduction of a new general purpose technology (GPT) in the form of information and communication technologies (ICT) over the past 25 years (Helpman 1998). In this paper we argue that this combination of shocks caused the developed economies to make the transition from an industrial to an entrepreneurial economy in response to new opportunities; moreover, the entrepreneurs in the developed countries changed the pattern of national and international specialization in such a way that the developed countries experience wage divergence among skill groups and increase the share of new, knowledge-intensive products and services in their economy. This corresponds with observed transition to the 'knowledge economy' and the 'rise of the creative class' that has been well established in the literature (Florida 2003).

Through outsourcing and FDI the developing and emerging economies on the other hand increasingly engage in the production of mature industrial goods (manufactures) and compete on the basis of their (static) comparative advantage, that is low wages. These countries enter the industrial era, but based on technology transfer that is largely initiated by international entrepreneurs.

It is quite clear from the empirical literature (e.g. Keller 1996) that not all countries make that transition equally successfully and that for example absorptive capacity is a key in attracting and benefiting from the existing international entrepreneurship. In addition, local entrepreneurs and firms in developing and emerging economies also seize new opportunities and engage in export (one might call that 'insourcing') or even initiate FDI themselves. Moreover, as countries develop, they can be expected to move from agricultural self-sufficiency with abundant low skilled labour, to industrial export-oriented with increasing levels of human capital to an entrepreneurial and services-oriented mature economy with skilled labour and sophisticated demand. In this paper, however, we choose to limit ourselves to analysing the world as if it consisted of two regions. One advanced region that produces advanced early stage innovative products and one developing region that produces routine, mature standardized products. We like to stress at this point that this simplification is not intended to be a statement about the world as it is but rather is a useful abstraction that allows us to zoom in on the mechanism we are primarily interested in.

To outline our basic argument we build on elements from life cycle trade models as in Krugman (1979) and Grossman and Helpman (1991), models of endogenous skill biased technical change as in Acemoglu (2002b) and Sanders (2005) and notions from the large literature on the entrepreneurial function surveyed by for example Audretsch and Acs (2005).

Our model shows how globalization and technological innovation drive the structural shift towards the entrepreneurial economy in the advanced region, but entrepreneurs in turn may drive the process of globalization and GPT exploration, both in the advanced and developing economy. We conclude from our analysis that the opening up and exploitation of opportunities for trade and GPT related products and services may have hurt especially the low skilled workers in advanced economies, but globalization through reduced political risks in the emerging countries unambiguously benefited all workers in both regions.

In the remainder of this paper we first offer the data and evidence from the literature that underlie the stylized facts we intend to explain: the rise of an industrial economy in (parts of) the developing world, the shifting patterns of international specialization, the shift in aggregate labour demand in the advanced countries and finally the rise of an entrepreneurial economy there. This section also presents the evidence in support of some key assumptions in our model, notably the product life cycle and the role of international entrepreneurs in actively relocating mature production activities to developing countries. Section 2 also establishes the coincidence of exogenous shocks we offer as the catalyst for these developments. Section 3 presents our arguments in a formal model, Section 4 analyses the implications and concludes.

2 Stylized facts

2.1 Political risk, global labour supply, and a new general purpose technology

Globalization and the advent of new ICT technology cannot reasonably be considered in isolation. It is obvious that the spectacular drop in the price of communication has been instrumental in allowing firms to expand their operations globally. It is also more than reasonable to assume that the development of ICT technology has benefited greatly from the boom in international demand for goods and services in general.

Globalization, however, would not have occurred to the degree that it has if the fundamental changes were restricted to the advent of the microprocessor and telecommunications. During the post-war era most trade and economic investment was confined to Europe and North America, and later a few of the Asian countries, principally Japan and the Asian Tigers. Technology alone could not have overthrown that, largely political, constellation. Trade with countries behind the iron curtain was restricted and in some cases prohibited. Even trade with Japan and other Asian and South American countries was highly regulated. Similarly, investments in politically unstable countries resulted in episodes of national takeovers and confiscation where the foreign investors lost all or part of their investments.

We therefore argue that it took a political revolution in significant parts of the world to reap the full benefits of these technological changes. The political counterpart of the technological

revolution was the increase in democracy and concomitant stability in areas of the world that had previously been inaccessible. As Thurow (2002: 25–26) pointed out, ‘Much of the world is throwing away its communist or socialist inheritance and moving towards capitalism. Communism has been abandoned as unworkable (China), imploded (the USSR), or has been overthrown (Central and Eastern Europe)’. Figure 1 illustrates this global political revolution by showing countries switching from one party (light shaded) or communist regimes (medium shaded) to liberal democracies (dark shaded) between 1950 and 2000.

The ‘victory’ of democracy and capitalism over communism also provoked a renewed commitment to the principles of free trade and international competition in countries such as India and Brazil. India, for example, became accessible as a trading and investment partner after opening its economy in the early 1990s. With some of these areas (re)joining the world economy for the first time in decades, the post-war equilibrium came to a sudden end.

What most distinguished the new players in the global economy was their relative abundance in cheap labour with comparatively low levels of education and productivity. For example, in the early part of the 1990s, the daily earnings of labour were estimated to be US$92.24 in the United States and US$78.34 in the European Union.

Figure 1: The Rise of democracy

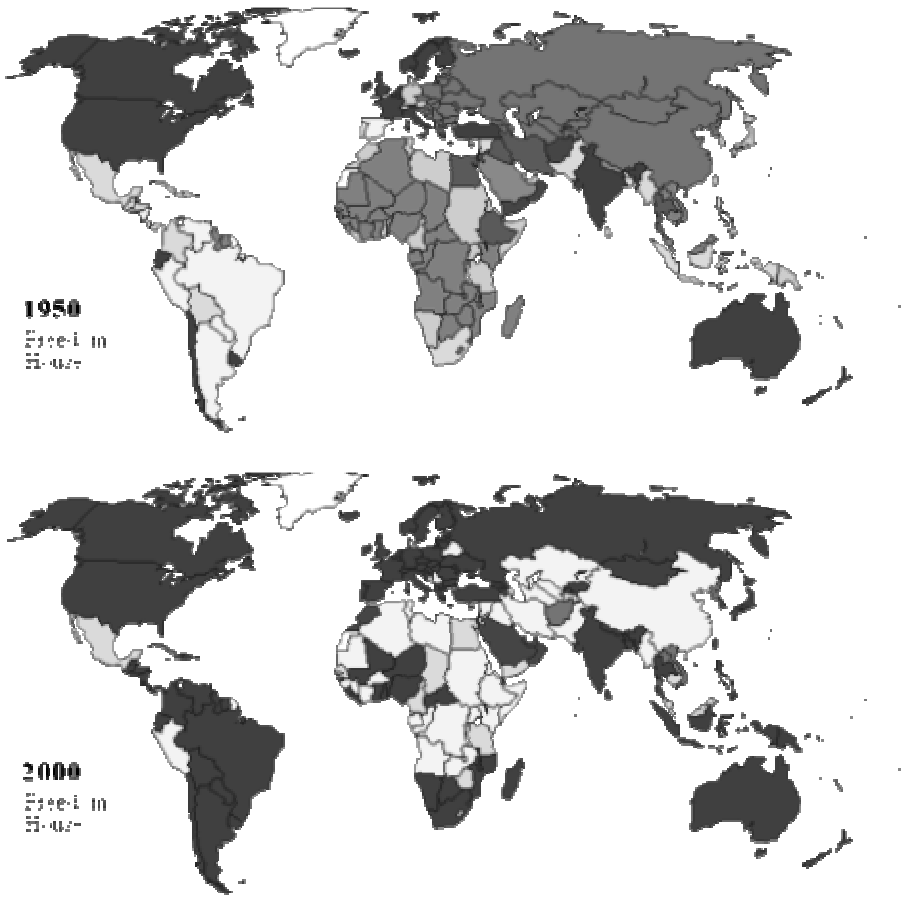
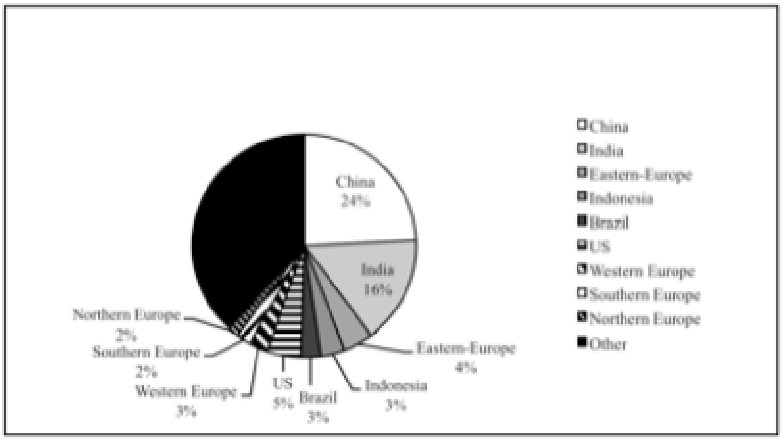


Figure 2: Share in global active population in 2005



Source: ILO (2005). Available at: http://www.ilo.org/public/english/bureau/stat/portal/index.html

This stood in sharp contrast to wages of only US$6.14 in Poland and US$6.45 in the Czech Republic shortly after the Berlin Wall fell. With Asia, the wage gap was even greater, as daily earnings were USUS$1.53 in China, USUS$2.46 in India and USUS$1.25 in Sri Lanka. Where previously trade barriers and political control kept their economies disconnected and allowed such disparity to persist, China and India alone now account for over one third of the world's active population.

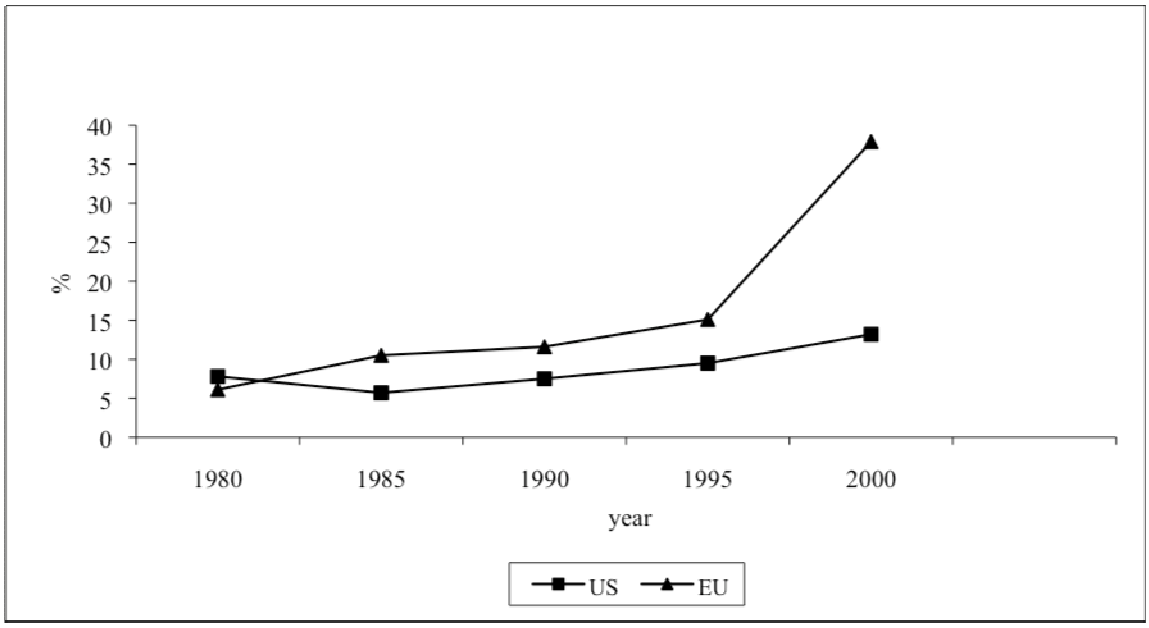
We thus establish Fact 1: **Globalization is characterized by the entry of large populous low wage economies**

The potential labour force in countries like China, with 1.3 billion and India with 1.1 billion inhabitants dwarfs the population and workforce in North America and Europe. The global economic system thus had to deal with a sudden expansion of the supply of cheap manual labour. In any market economy the response to such a shock is predictable. In the incumbent players' economies the wages decline for the jobs such workers can do and rise in complementary occupations (including the production of non-tradables). In addition, following standard Heckscher–Ohlin trade theory, one expects a shift in international trade patterns and increasing standards of living in the new entrant countries. The data over the past 10 years show all these trends.

But globalization is certainly not all 'bad news' for the North. The political revolution created opportunities for entrepreneurs associated with the gaping labour cost differences and the emerging markets for their products. As long as the Wall stood, and countries such as China and Vietnam remained closed, the large discrepancies in wage rates could be maintained without eliciting responses in trade and FDI.

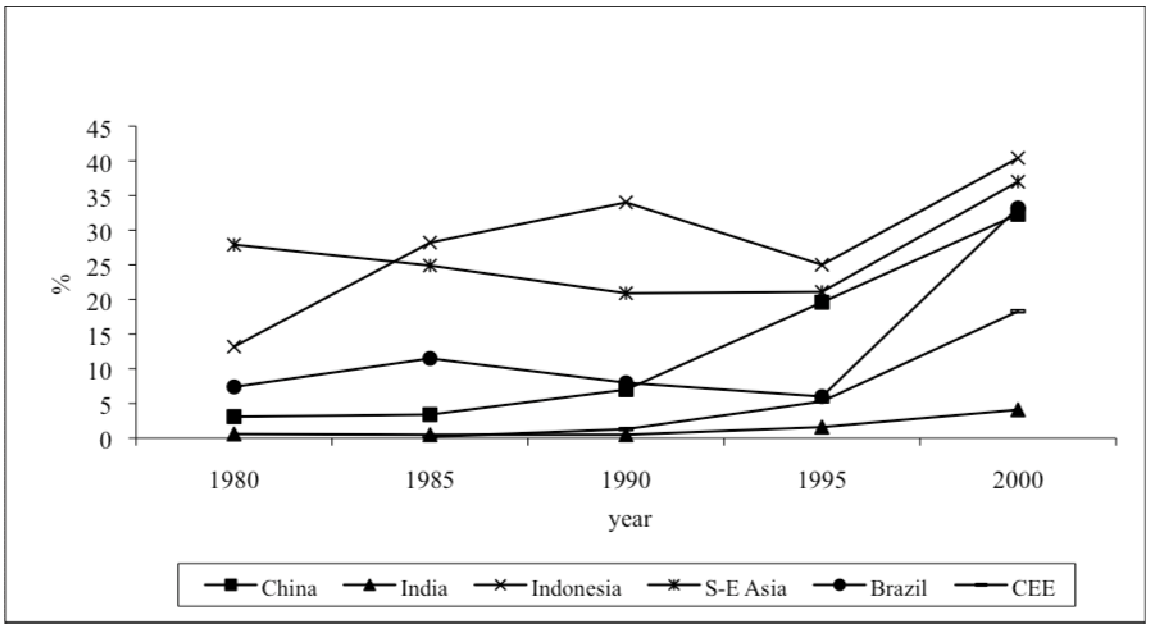
Trade with and certainly direct investment by foreign companies was simply prohibited by local governments or considered to be too risky.

Figure 3: FDI outflow in % GDP



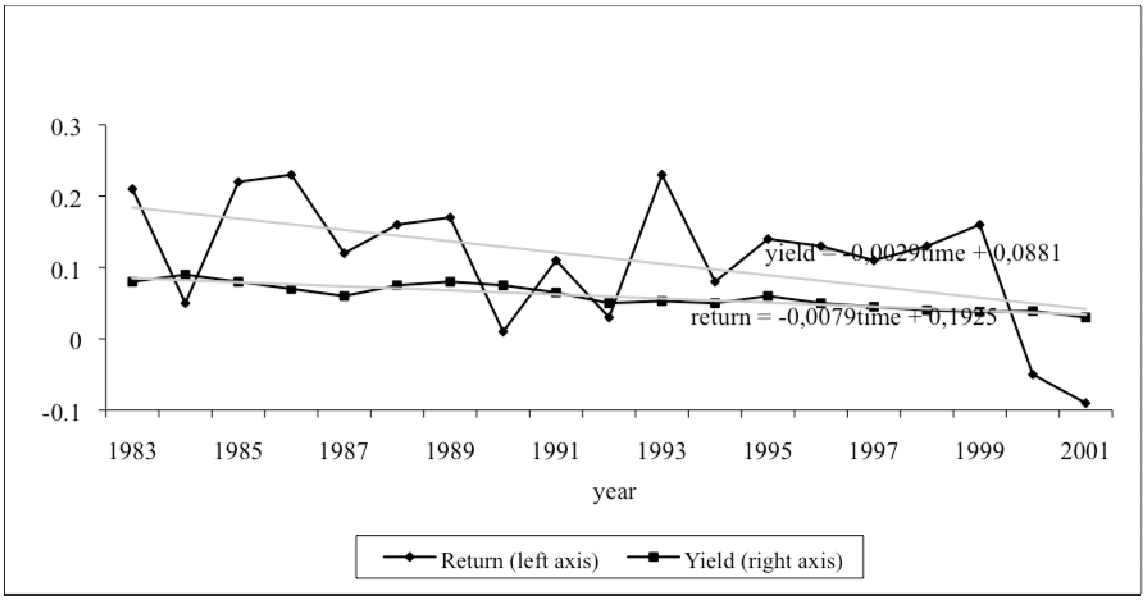
Source: UNCTAD (2003).

Figure 4: FDI inflow in % GDP



Source: UNCTAD (2003).

Figure 5: Returns on US foreign assets



Source: Data taken from Lane and Milesi-Feretti (2003), figure 10: 31.

With opening up to trade and FDI these countries allow Northern entrepreneurs to step in and arbitrage away such differentials by outsourcing and off-shoring, making good money in the process.[1]

The political shift also had a huge impact on global business opportunities. As can be verified in Figures 3 and 4 volumes of FDI increased rapidly between 1990 and 2000. Meanwhile one can verify in Figure 5 that the rate of return and yield on foreign assets fell between 1983 and 2001 (by 8 and 3 basis points on average per year, respectively), indicating a drop in risk premia as Western investors apparently were willing to invest larger amounts at lower rates of return.

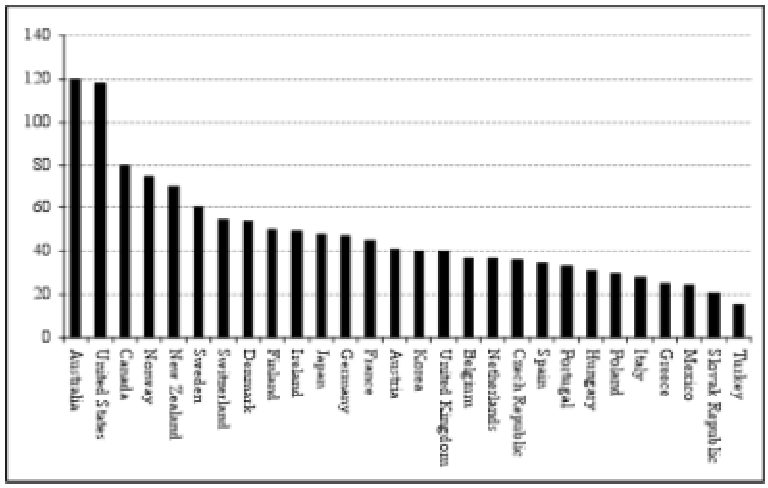
And we establish fact 2: **Political risks declined worldwide**

The Northern entrepreneurs were aided and facilitated in setting up such operations by the recently developed information and communications technologies that virtually destroyed distance and provoked serious reorganization of production in itself. This new GPT predates the fall of the Wall but the North was still in the middle of exploring and realizing its full potential when political events added an international dimension to the exploration process and provided new and highly profitable opportunities for application. It is well-established that ICT can be considered a GPT (in fact the concept was developed with ICT in mind by Bresnahan and Trajtenberg 1995).

1 Outsourcing refers to placing parts of the production chain out of the firm and does not necessarily cross international borders. Off-shoring refers to placing (parts of) the firms activities abroad but maintaining control.

As Figure 6 illustrates, by 2000 most OECD countries have over 40 per cent of their workforce using computers.

Figure 6: PCs per 100 white-collar workers



Source: OECD (2005).

Its rapid introduction in all aspects of the Northern way of life cannot have escaped anyone but the smallest infants and most senile senior citizens. Obviously, by 'destroying distance' this technology was particularly effective in reducing the costs of global operations.

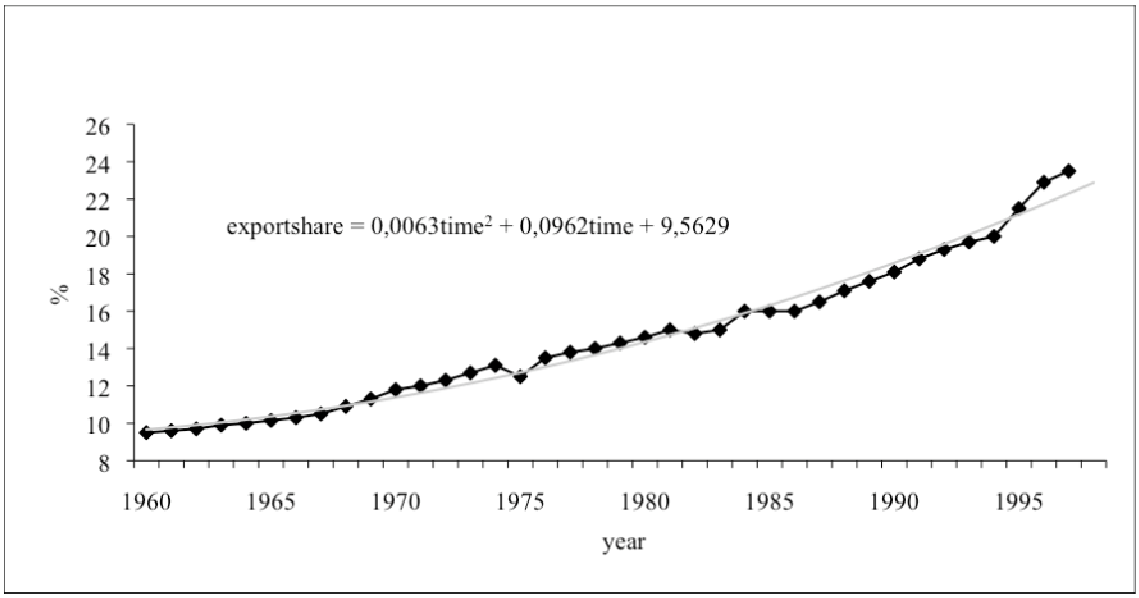
This establishes the third fact: **ICT technology is a pervasive GPT**

We conclude that the drop in political risk, the expansion of the low skilled labour force in the South and the introduction of a new GPT are the fundamental exogenous events that triggered structural change in the last quarter of the 20th century. They all created new opportunities for Northern entrepreneurs to the extent that they took a leading role in shaping global production and trade. Their response to these new opportunities is what effectuated the changes we set out to explain. Before proceeding with modelling their role, however, we first establish those changes as empirically relevant facts in North and South.

2.2 Shifting international specialization and the industrial economy in the South (East)

A first indication of changing patterns of global economic activity is given by the more traditional measures of transnational activity. These traditional measures include trade (exports and imports), FDI (inward), international capital flows, and inter-country labour mobility. The overall trend for all of these measures has been strongly positive.

Figure 7: Share of exports in world GDP



Source: Data taken from Torres (2001), figure 1: 11.

Both exports and imports have become more important and accounted for a greater share of economic activity. Total world exports increased from US$1.3 trillion in 1970 to nearly US$5 trillion in 2000, in constant dollars and exports have increased their share in total output consistently since 1820 (Torres 2001: table 1), but as Figure 7 shows also accelerates since the 60s.[2] Exports matter absolutely, relatively and increasingly.

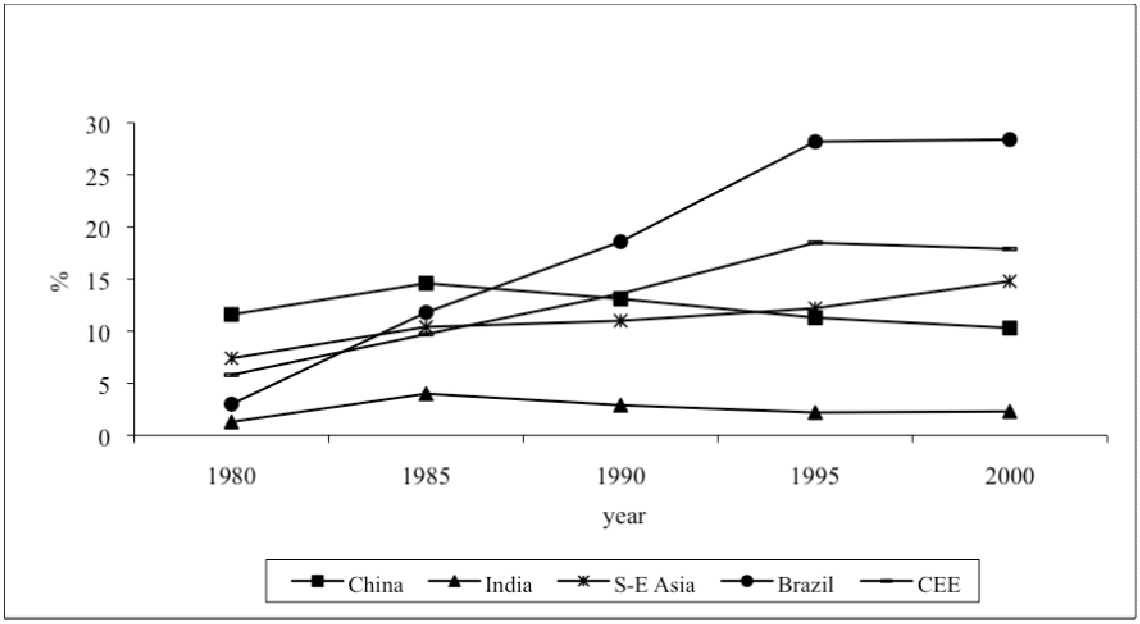
Of course higher total exports could simply be more of the same products by the same players crossing more borders. But this is not the case. The economic structure has fundamentally changed over the past 25 years in the developing South. Where the South previously relied on local production, agricultural, and natural resources exports while importing most manufactures, they now increasingly compete for a share in the global manufactures and even services markets. Especially in South-East Asia, where land/labour ratios are low, manufacturing, not agriculture and/or mining is the key sector of economic growth. Mayer and Wood (1999) predicted that the large economies of China and India would grow towards manufacturing shares between 70–80 per cent of exports and by the mid nineties these countries had already reached those levels. China and India are by far the most impressive examples of rapid industrialization in the region but as OECD (2005) shows the overall non-OECD share in world trade and manufactures is increasing steadily.

A closer look at the data shows that it is especially intermediate industrial products from South-East Asia that are responsible for this upward trend (see WTO 2005 and Feenstra and Hanson 2004). In several countries in South-East Asia and some in South America, industrial employment and output shares rose as a result of this outsourcing wave and by the turn of the last

2 Longer time series show a stagnant period in the Interbellum (1918–39) and First and Second World War for well-known and obvious reasons. The export share in 1913 was 8.7 per cent and in 1950 stood at 7 per cent of global GDP.

century various industrialization processes have gained momentum to the point that it is fair to speak of emerging industrial societies.

Figure 8: FDI inflow in % GFCF



Source: UNCTAD (2003).

In Taiwan and South Korea for example, employment in agriculture has dropped to around 10 per cent, a level comparable to that of New Zealand today and half that of the Netherlands in 1950. The large populous economies in the East are also rapidly industrializing and with over 50 per cent of the workforce still in agriculture have a huge industrial labour reserve yet to absorb. Evidence presented by Antras (2005) suggests that Northern investors and entrepreneurs played a vital role in fueling these waves of industrialization.[3] International flows of capital and in particular of FDI towards these new kids on the industrialized block have exploded since the late 1980s and increasingly substituted for domestic savings as a source of gross fixed capital formation (GFCF).

In general it is fair to say that the rise of industrial production in the South, at least in its initial stages, was actively promoted by actions of economic agents from the North.

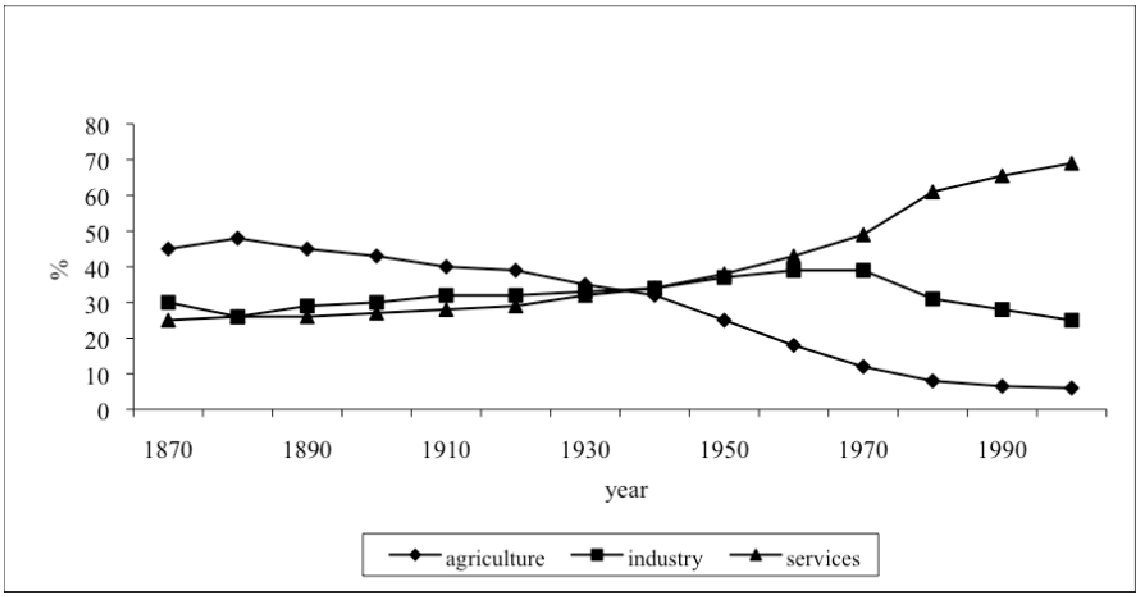
We thus establish fact 4: **Northern Entrepreneurs fueled South-(East)-ern industrialization**

2.3 Shifting labour demand and the entrepreneurial economy in the North

In the North, meanwhile, traditional industrial employment in large industrial firms has been falling as production was relocated. However, overall employment and output have still grown, mainly due to small firm job creation in ICT related services. The well-known transition towards the services economy is clearly illustrated in Figure 8.

3 Antras (2005) offers an incomplete contract model to explain why northern firms and entrepreneurs, rather than southern imitators are the main initiator and vehicle of international technology transfer.

Figure 9: Employment shares in 17 OECD countries

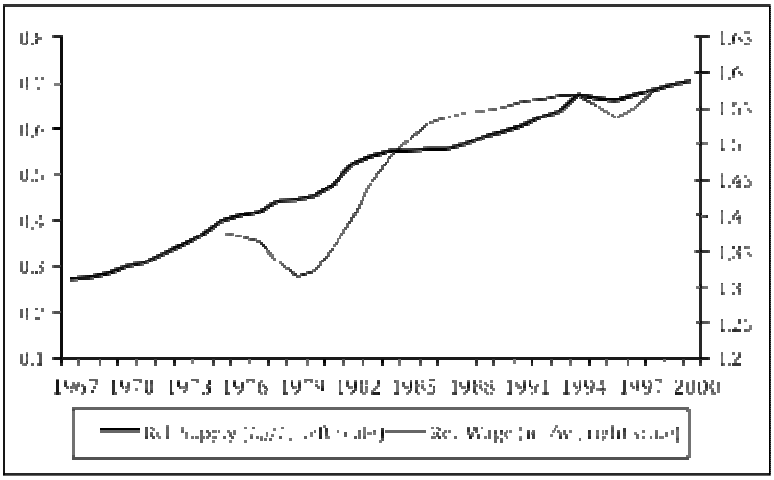


Source: Data were taken from Iversen and Rosenbluth (2006), figure 4: 29.

In particular the widening gap between industry and services since 1970 indicates an unprecedented labour reallocation. Arguably for the first time in a time span that is considerably shorter than the average career, making life long employment a rarity and firm and industry specific skills a more risky investment than before.

A closely related phenomenon is the rapid increase in the knowledge intensity of production, both in industry and services in the North. The trends away from low skilled manufacturing in OECD labour markets have been well-documented indeed (Katz and Autor 1999; Juhn et al. 1993; Gottschalk and Moffit 1994; Goldin and Katz 2001; Nickell and Bell 1996; and Acemoglu 2002a). Figure 9 shows how relative wages have been decreasing in the United States for low skilled workers in spite of strong increases in the average educational level, suggesting massive relative demand shifts away from low skilled labour.

Figure 10: Relative wage and supply US 1967–2000



Source: Card and DiNardo (2002).

A similar demand trend, even if wage changes were often less dramatic, has been identified for virtually every OECD country (see for example Autor et al. (2005) for recent evidence on the US and Machin and Van Reenen (1998) or Sanders and ter Weel (2000) for surveys of the evidence on the OECD).

For example Autor et al. (1998) showed that the use of new technology, particularly new ICT related technologies, was highly correlated with the drop in unskilled labour demand. The link between technology and labour demand was further explored empirically by Berman et al. (1994), Machin and van Reenen (1998), Krusell et al. (2000) and Doms et al. (1997).

Models to explain the technology-skilled labour–demand nexus can be found in Acemoglu (2002b) and Sanders (2005). Acemoglu attributes skill biases in technical change to the market size effect, which claims that technology was designed to be using skilled labour because the skilled labour supply increased in the 1970s. Sanders on the other hand claims, in accordance with Schultz (1961) that technology is skill biased by nature when it is new.

This is the essence of a life cycle model and the evidence seems to support the latter type of model. Greenwood and Uysal (2004) make the case compellingly. The number of firms per capita and trademarks granted has exploded over the 1980s in the US. Kortum and Lerner (1997) show a similar speed-up in patenting and most activity obviously takes place in the new technology fields such as biotech and software. All this increased activity indicates high levels of grassroots entrepreneurship and product innovation, which in Greenwood (1997) but also in life cycle models causes temporary shifts in the relative demand for skilled labour.

Another strand of literature, e.g., Caroli and van Reenen (2001), Bresnahan et al. (2002) would focus more on the effects of technology through the organization of work, rather than on characteristics of the new technologies per se. According to their evidence, the activities within firms have shifted towards design, sales, marketing, etc. whereas production itself was gradually automated, outsourced, or even off-shored.

Piva et al. (2005) find evidence of a mutually reinforcing effect. In a recent and careful re-evaluation of the evidence for the USA, Autor et al. (2005) conclude that technology and organizational change tend to ‘polarize’ the demand for labour.[4] It is the intermediate level workers that are being replaced by technology.

Meanwhile changing trade patterns also affected the North. The trade of goods tripled between 1985 and 1996 while the trade of services increased by more than three times over this time period. While some of this increase in the world export rate is attributable to an increased participation in international trade by countries, which had previously been excluded, export rates in the leading industrialized countries have also increased over the past three decades. For example, US exports and imports have increased from 11 per cent of GDP in 1970 to more than

4 It is likely that the evidence for skill polarization is less pronounced in the European welfare states, where a large low skilled service sector is absent and skill levels tend to be higher for the least educated.

25 per cent by 1999. [5] Exports as a share of GDP for 49 other developed countries have risen from around 18 per cent in 1982 to around 25 per cent by 1999.

Evidence, collected by Feenstra and Hanson (1996; 1999; 2004), shows that over the 1980s and 1990s the import of intermediate (manufactured) goods has almost doubled from 6.5 to 11.6 per cent of total intermediate purchases in the US. More open economies are likely to show much higher levels and similar increases.

The increase in world trade is also not attributable to the influence of just a few industries or sectors, but rather systematic across most parts of the economy. The exposure to foreign competition in manufacturing increased by about one-sixth in the OECD countries. The exposure to foreign competition increased in every single OECD country, with the exception of Japan. In addition, it increased in most of the manufacturing industries.

The way we read the evidence is that globalization combined with technological change, and in particular the information technology and communication technologies breakthroughs, had rendered the comparative advantage in low technology and even traditional moderate technology industries incompatible with high wage levels. At the same time, the emerging comparative advantage that is compatible with high wage levels is based on innovative and knowledge-intensive activities. There are many indicators reflecting the shift in the comparative advantage of the high wage countries towards an increased importance of such activities. For example, the ICT sector of the USA has experienced an increase in the annual growth rate from 5 per cent in 1991 to nearly 20 per cent by 1998. By contrast, the rest of the economy experienced fairly steady growth at around 3 per cent over this period. Before we turn to the role of the entrepreneur in this 'new' economy we establish fact 5:

Fact 5: **The North has experienced de-industrialization and a changing relative labour demand towards skilled non-production workers**

Increased globalization of economic activity seemingly also condemned entrepreneurship, in the form of new firm start-ups and small firms, to extinction. Or at least there seemed to be only an even more diminished role than in the capital driven Solowian Industrial Economy. Caves (1982: 53) argued that the additional costs of globalization that would be incurred by small business 'constitute an important reason for expecting that foreign investment will be mainly an activity of large firms'. Certainly the empirical evidence by Horst (1972) showed that even after controlling for industry effects, the only factor significantly influencing the propensity to engage in FDI was firm size. As Chandler (1990: 130) concluded, 'to compete globally you have to be big'. Thus, it was particularly startling and a seeming paradox, when scholars first began to document that what had seemed like the inevitable demise of entrepreneurship actually began to reverse itself starting in the 1970s.

Loveman and Sengenberger (1991) and Acs and Audretsch (1993) carried out systematic international studies examining the re-emergence of small firms and entrepreneurship in North America and Europe. Two major findings emerged from these studies. First, the relative role of

5 'Markets Go Global', *The Economist*, 20 September, 1997.

small firms varies systematically across countries, and secondly, in most European countries and in North America, small firms began increasing their relative importance starting in the mid-1970s. In the USA the average real GDP per firm increased by nearly two-thirds between 1947 and 1980, from US$150,000 to US$245,000, reflecting a trend towards larger enterprises and a decreasing importance of small firms. However, within the subsequent seven years, by 1987, it had fallen by about 14 per cent to US$210,000 (Brock and Evans 1989). Similarly, small firms accounted for one-fifth of manufacturing sales in the USA in 1976, but by 1986 the small firm share of sales had risen to over one-quarter (Acs and Audretsch 1990).

It was in the area of job generation that the recent emergence of entrepreneurship was first identified. In 1981 David Birch revealed the startling findings from his long term study of US job generation. Birch (1981: 8) found that, 'Whatever else they are doing, large firms are no longer the major providers of new jobs for Americans'. Instead, he discovered that most new jobs emanated from small firms. More recently, Davis et al. (1996a; 1996b) corrected for the regression to the mean fallacy which they claim is inherent in Birch's results. While their quantitative results differ from Birch's, their study still indicates that small firms account for more than their share of new employment. In particular, in their study large firms created 53 per cent of the new jobs but their employment share is 65 per cent. At the same time, large firms destroyed 56 per cent of the jobs, which is greater than their share of new jobs created. Their measure was static in nature and gave no indication whether this share has been increasing or decreasing over time. Still the results indicate that small firms are net job generators, while large firms shed labour.

The rise in entrepreneurial activity is not particular to the US. The changes in employment shares in Europe are telling. The small firm employment share in manufacturing in the Netherlands increased from 68.3 per cent in 1978 to 71.8 per cent in 1986; in the United Kingdom from 30.1 per cent in 1979 to 39.9 per cent by 1986; in (West) Germany from 54.8 per cent in 1970 to 57.9 per cent by 1987; in Portugal from 68.3 per cent in 1982 to 71.8 per cent in 1986; in the North of Italy from 44.3 per cent in 1981 to 55.2 per cent by 1987, and in the South of Italy from 61.4 per cent in 1981 to 68.4 per cent by 1987 (Acs and Audretsch 1993). An EIM study documents how the relative importance of SMEs in Europe (19 countries), measured in terms of employment shares has continued to increase between 1988 and 2001 (EIM 2002).

Methodologies similar to Birch's were also used in the European context to assess the contribution to new job generation. In one of the first studies Gallagher and Stewart (1986) and Storey and Johnson (1987) found similar results for the United Kingdom. Konings (1995) linked gross job flows in the United Kingdom to establishment size and finds that the gross job creation rate is the highest in small establishments and the lowest in large establishments. By contrast, the gross job destruction rate is the lowest in small establishments and the highest in large establishments.

Evidence from Sweden (Heshmati 2001) also suggests that employment creation is negatively related to firm size based on data from the 1990s. Similarly, Hohti (2000) finds that gross employment creation and destruction are negatively related to firm size in Finland. Using data from Finnish manufacturing between 1980–94, Hohti (2000) finds that the annual job flow rates, in terms of births and deaths, is similar to that identified by Broesma and Gautier (1997: 216) for

Dutch manufacturing firms and by Klette and Mathiassen (1996) for Norwegian manufacturing firms. In particular, new establishments have the greatest job creation rates as well as the greatest rates of job destruction. Thus, the evidence from Finland, as well as from Sweden, and the Netherlands, suggests entrepreneurial dynamics similar to those found in North America. Hence, the weight of the empirical evidence on employment generation is remarkably robust and indicates that the role of entrepreneurship in employment generation in Europe is consistent with the findings for the United States. The reversal of the trend towards large enterprises and the re-emergence of small firms were not limited to employment only. For example, in the Netherlands the business ownership rate fell during the post-war period, until it reached a trough of 0.085 in 1982. But this downward trend was subsequently reversed, rising to a business ownership rate of 0.10 by 1998 (Audretsch et al. 2002).

Small and new enterprises are therefore increasingly important qualitatively, as a mode of organization and operation, and quantitatively as an engine of employment creation on both sides of the Atlantic. In addition it should be emphasized that an important qualification of the 'Job Generation' literature, is that it only links employment changes of the firm to the size and in some cases the age of the firm. This means that the performance criterion is not focused on aggregate employment changes, but employment changes at the level of the firm. This implicitly assumes that there is no externality or spillover from one enterprise to other firms. At this point we feel confident to state fact 6:

Fact 6: **Entrepreneurial activity has risen**

And with this fact we complete our list of facts to explain and be explained in the model we develop in the next section. Section 2.4 wraps up this section first.

2.4 Summary

This section has established the facts we intend to explain and those we intend to use as explanation. We intend to explain how political liberalization and technology have interacted and offered the Northern entrepreneurs the opportunities they needed to transform trade and production patterns and shape what we know as globalization and the knowledge economy.

We have shown that:

1. Labour abundant countries have joined the global economic system

2. Political risk has declined in the world

3. Information and Communication Technologies is a General Purpose Technology that fuels globalization.

4. Arguably, these developments are exogenous to the economic system we consider. Starting from these observations we speculated that they may cause:

5. FDI driven industrialization in the South(East)

6. De-industrialization and shifting relative labour demand in the North

7. Increased entrepreneurial activity in innovation, outsourcing, and off-shoring.

The next section presents a model where the link between cause and effect is formalized.

3 The model

Aspects involving the decision to locate production in foreign countries are certainly not a new subject and have been studied in the context of so called product life cycle models since Vernon coined the term in 1966. He linked the location of production activities to the life cycle stage of the product, hypothesizing that new products, because of their higher knowledge intensity, would be produced in the North, that has a relative abundance of skilled labour and therefore a comparative advantage in their production. Krugman (1979) formalized Vernon's idea in a model but assumed that technology generation and transfer are both exogenous processes. Grossman and Helpman (1991) used the insights of endogenous growth theories to endogenize the process of innovation and imitation. In these models, however, no distinction is made between skilled and unskilled labour. Moreover, Grossman and Helpman are also not explicit about the role of Northern agents in initiating the transfer of technology across geographic space. Instead they assume that R&D undertaken in the South drives technology diffusion by copying ideas off the shelve from the North.

In this tradition we now present a model that distinguishes among three stages in the life cycle of products. The first stage is initiated by the discovery of a new product. Upon discovery, an entrepreneur in the North will introduce the new product or service into the Northern economy. The second stage occurs when the product matures, leading the incumbent firm to apply firm-based R&D to the standardization and routinization of the production process, driven by the desire to cut costs. As the production process becomes standardized, less skilled workers in the North can then be engaged in the production process at relatively low wages. However, so can Southern workers. Still, we assume that the act of moving production abroad marks the beginning of a separate third and final stage in the product life cycle. Setting up production facilities in the South is neither costless nor riskless and requires an entrepreneurial act. We assume that a Northern entrepreneur initiates this process as copying behaviour is important especially after Northern entrepreneurs have set up shops in the South. We therefore assume that it is FDI, not Southern imitation R&D that will be the medium of knowledge spillover.

By endogenizing the allocation of entrepreneurial talent over product innovation, process innovation, and outsourcing/off-shoring, we can explain the dynamics in global specialization patterns as the result of political risks falling and low skilled labour abundant countries joining the global economy. We also show that the introduction of a so called GPT drives the Northern economy further towards what we have coined the entrepreneurial economy above; a production structure that relies heavily on new goods production and product innovation for creating value added.

The model structure follows that of a standard endogenous growth with variety expansion in a final goods model. First we assume identical time separable preferences globally and derive consumer demand for goods over time solving:

$$\max_{E_t} : \int_t^{\infty} e^{-\rho(\tau - t)} \log(E_\tau / P_\tau) d\tau$$
$$s.t. : Y_t + rA_t = E_t + \dot{A}_t \qquad (1)$$

where E is expenditure on consumption, P is the price of a unit of direct utility, ρ is the discount rate, Y is income, A is the level of assets and a dot over a variable signifies the time derivative. This problem yields the familiar Ramsey result:

$$\dot{E}_t / E_t = r - \rho \qquad (2)$$

Then we assume a standard Constant Elasticity of Substitution (CES) love-of-variety instant utility function and solve:

$$\max_{c_i} : U = \left(\int_0^n {c_i}^{\alpha} di \right)^{1/\alpha} \qquad \text{where } 0 \leq \alpha \leq 1 \qquad (3)$$
$$s.t. : \int_0^n c_i p_i di \leq E$$

i indexes a single good and n is the total number of goods consumed. c and p are quantity and price of a single good in the basket. To derive the instant global demand functions for all current and future goods in this CES-utility function is straightforward:[6]

$${c^D}_i = \left(\frac{p_i}{P} \right)^{\frac{1}{\alpha - 1}} \frac{E}{P} \qquad \text{where } P \equiv \left(\int_0^n {p_i}^{\frac{\alpha}{\alpha - 1}} di \right)^{\frac{\alpha - 1}{\alpha}} \qquad (4)$$

P is defined as the minimum cost of one unit of direct utility, U.

Now consider production. Following the life cycle literature we assume that products in their early stages can only be produced in the North. The reason is that early stage production requires high flexibility and creativity as well as frequent feedback from the consumer. Northern skilled workers and sophisticated consumers provide the required setting. All these early stage aspects give skilled workers a competitive advantage in production (Schultz (1961). As there is also a large tacit knowledge spillover required from inventor to innovator and early stage producer, it is reasonable to assume that a new product is initially produced by only skilled workers and only in the North.

At that stage the producer therefore faces no competition, at home or abroad, allowing him to set monopoly prices:

$$\max_{p_i} : \pi_i = c_i p_i - {w^N}_H {l^N}_{Hi}$$
$$s.t. : c_i = {c^D}_i \qquad (5)$$
$$s.t. : y_i = {b^N}_H {l^N}_{Hi}$$

6 See for example Grossman and Helpman (1991).

where w^N_H is the high skilled wage in the North, l is the amount of labour employed. Note also that labour is the only factor of production and the production volume, y is assumed linear in labour employed. This yields:

$$p_i = \frac{w^N_H}{\alpha b^N_H} \qquad \forall n \in n^N_H \tag{6}$$

As a product matures the incumbent producer will invest in R&D to come up with a process that allows the product to be produced by low skilled workers in the North.[7] This will reduce costs and hence increases profits. At the mature stage, however, the market will no longer be uncontested. The fired skilled workers can always set up a new firm and set their price equal to marginal costs:[8]

$$p_i = \frac{w^N_H}{b^N_L} \tag{7}$$

the incumbent, however, using the mature production technology, has lower marginal costs and can retain the entire market and prevent entry by setting his price equal to:

$$p_i = \min\left[\frac{w^N_L}{\alpha b^N_L}, \frac{w^N_H}{b^N_H} - \varepsilon\right] \tag{8}$$

where ε is close to 0. However, the new production process also creates the possibility of outsourcing the production. To enable Northern low skilled workers to compete against the high skilled workers, production must be routinized and many routines are embedded into machines, interfaces, and procedures. Such codifications, however, can also be transferred (at some cost) abroad. The Northern producer must therefore now fear competition from abroad. His only edge is the potentially higher marginal productivity of Northern low skilled labour.[9] If profitable entry from abroad is feasible the incumbent is not likely to engage in that activity. It typically takes an entrepreneur to set it up, take the risks and, if successful, reap the benefits. Products that have been outsourced have a price:

$$p_i = \min\left[\frac{w^S_L}{\alpha b^S_L}, \frac{w^N_L}{b^N_L} - \varepsilon\right] \tag{9}$$

and in our model compete out production in the North entirely. For given n, n^N_H, n^N_L and n^S_L the labour markets for Northern skilled, unskilled and Southern labour can now be assumed to clear, such that the model equilibrates. We require:

---

7 Note that in fact we assume that products only mature as the incumbent producer engages in such R&D. It is not an automatic process as for example in Krugman (1979) or Arrow (1962).

8 Here we have to assume they cannot as long as the firm employs them. Some non-disclosure agreements typically ensure that they do not infringe upon the incumbents profits while and even some time after being employed there.

9 In reality there is all kinds of competitive advantages. The Northern incumbent may enjoy lower transportation costs to the largest markets, protective tariffs and subsidies, complementary sectors, etc. etc.

$$L^N{}_H^* = \int_{n^N{}_L + n^S{}_L}^{n} \alpha^{\frac{1}{1-\alpha}} b^{\frac{\alpha}{1-\alpha}} EP^{\frac{\alpha}{1-\alpha}} \left(w^N{}_H\right)^{\frac{1}{\alpha-1}} di = n^N{}_H \left(\alpha^{\frac{1}{1-\alpha}} b^{\frac{\alpha}{1-\alpha}} EP^{\frac{\alpha}{1-\alpha}} \left(w^N{}_H\right)^{\frac{1}{\alpha-1}} \right)$$

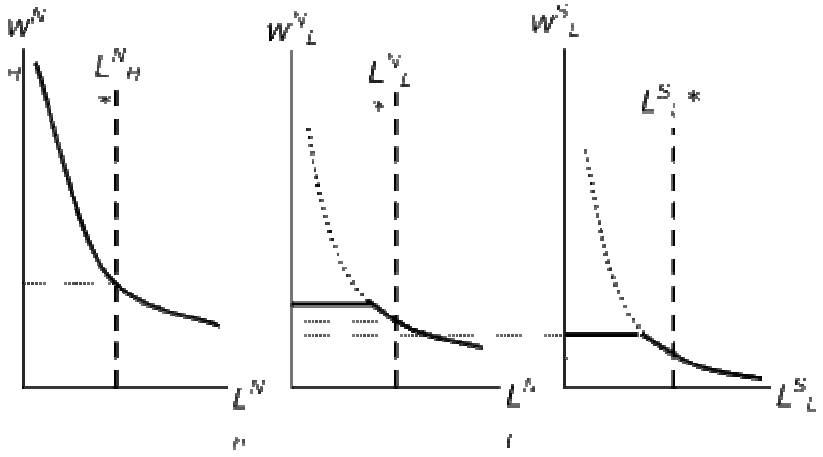
$$L^N{}_L^* = \int_{n^S{}_L}^{n-n^H{}_L} b^{-1} EP^{\frac{\alpha}{1-\alpha}} \left(\min\left[\frac{w^N{}_H}{b}, \frac{w^N{}_L}{\alpha b} \right] \right)^{\frac{1}{\alpha-1}} di = n^N{}_L \left(b^{-1} EP^{\frac{\alpha}{1-\alpha}} \left(\min\left[\frac{w^N{}_H}{b}, \frac{w^N{}_L}{\alpha b} \right] \right)^{\frac{1}{\alpha-1}} \right)$$

$$L^S{}_L^* = \int_{0}^{n^S{}_L} b^{-1} EP^{\frac{\alpha}{1-\alpha}} \left(\min\left[\frac{w^N{}_L}{b}, \frac{w^S{}_L}{\alpha b} \right] \right)^{\frac{1}{\alpha-1}} di = n^S{}_L \left(b^{-1} EP^{\frac{\alpha}{1-\alpha}} \left(\min\left[\frac{w^N{}_L}{b}, \frac{w^S{}_L}{\alpha b} \right] \right)^{\frac{1}{\alpha-1}} \right)$$

(10)

Although this set of equations cannot be solved analytically, due to the discontinuities in the demand curves, one can analyse the equilibrium graphically and sequentially. First consider the market for high skilled workers in the North in the left panel.

Figure 11: Labour market equilibrium



Source: compiled by the authors.

There is no competition in this market, implying that prices are always set to profit maximization levels and consequently the demand curve is continuous. Confronted with exogenous supply this yields an equilibrium wage at $w^N{}_H^*$. Given that wage the marginal costs in the new goods sector are given by $w^N{}_H^*/b$, which puts an upper limit on prices in the mature Northern sector. Beyond that price demand for goods falls to 0, so demand for labour falls to 0. Therefore the demand curve has a horizontal section at the low skilled wage that would imply a profit maximizing price is set equal to $w^N{}_H^*/b$. This is the case at $w^N{}_L = \alpha w^N{}_H^*$. Then the kinked curve is confronted with exogenous supply and we obtain the Northern equilibrium low skilled wage. By similar argument one can also construct the demand for Southern low skilled labour and solve the final market. All labour markets equilibrate simultaneously for all given combinations of n, $n^N{}_H$, $n^N{}_L$

and n^S_L. n, n^N_H, n^N_L and n^S_L, however, will not be constant over time. The assumption of imperfect competition implies there are rents in the model and therefore there is an incentive for new entrants. Consider the effects on profit flows and ultimately the value of being a producer in the three stages of the life cycle. With prices set as above, there are four scenarios that we need to consider. The cost gaps between high and low skilled labour using producers in the North and between Northern and Southern low skilled labour using producers can be wide or narrow respectively. Hence profits for the three types of activity under these conditions are given in Table 1. The most important result in Table 1 is the fact that profits are always positive and in steady state equilibrium, where relative wages and relative sector sizes are constant, proportional to total expenditures and inversely proportional to their own sector size. Given these profit flows it is therefore worthwhile to engage in entrepreneurial activity, product development, and outsourcing/off-shoring.[10]

10 Obviously it is worthwhile only if the discounted present value of this profit flow exceeds the costs of making the required innovation.

Table 1

Profits under various scenarios

Gap n^N_L-n^S_L		Gap n^N_H-n^N_L Wide	Gap n^N_H-n^N_L Narrow
Wide	π^N_H	$\frac{(1-\alpha)E}{n^N_H}\left(1+\frac{n^N_L}{n^N_H}\left(\frac{w^N_L}{w^N_H}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_L}{b^N_H}\right)^{\frac{\alpha}{1-\alpha}}+\frac{n^S_L}{n^N_H}\left(\frac{w^S_L}{w^N_H}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^S_L}{b^N_H}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$	$\frac{(1-\alpha)E}{n^N_H}\left(1+\frac{n^N_L}{n^N_H}\alpha^{\frac{\alpha}{\alpha-1}}+\frac{n^S_L}{n^N_H}\left(\frac{w^S_L}{w^N_H}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^S_L}{b^N_H}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$
	π^N_L	$\frac{(1-\alpha)E}{n^N_L}\left(1+\frac{n^N_H}{n^N_L}\left(\frac{w^N_H}{w^N_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_H}{b^N_L}\right)^{\frac{\alpha}{1-\alpha}}+\frac{n^S_L}{n^N_L}\left(\frac{w^S_L}{w^N_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^S_L}{b^N_L}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$	$\frac{(1-\alpha)E}{n^N_L}\left(1+\frac{n^N_H}{n^N_L}\alpha^{\frac{\alpha}{1-\alpha}}+\frac{n^S_L}{n^N_L}\left(\frac{w^S_L}{w^N_H}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{\alpha b^S_L}{b^N_H}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$
	π^S_L	$\frac{(1-\alpha)E}{n^S_L}\left(1+\frac{n^N_L}{n^S_L}\left(\frac{w^N_L}{w^S_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_L}{b^S_L}\right)^{\frac{\alpha}{1-\alpha}}+\frac{n^N_H}{n^S_L}\left(\frac{w^N_H}{w^S_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_H}{b^S_L}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$	$\frac{(1-\alpha)E}{n^S_L}\left(1+\frac{n^N_L}{n^S_L}\left(\frac{w^N_H}{w^S_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_H}{\alpha b^S_L}\right)^{\frac{\alpha}{1-\alpha}}+\frac{n^N_H}{n^S_L}\left(\frac{w^N_H}{w^S_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_H}{b^S_L}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$
Narrow	π^N_H	$\frac{(1-\alpha)E}{n^N_H}\left(1+\frac{n^N_L}{n^N_H}\left(\frac{w^N_L}{w^N_H}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_L}{b^N_H}\right)^{\frac{\alpha}{1-\alpha}}+\frac{n^S_L}{n^N_H}\left(\frac{w^N_L}{w^N_H}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^S_L}{\alpha b^N_H}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$	$\frac{(1-\alpha)E}{n^N_H}\left(1+\frac{n^N_L}{n^N_H}\alpha^{\frac{\alpha}{\alpha-1}}+\frac{n^S_L}{n^N_H}\left(\frac{w^N_L}{w^N_H}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_L}{\alpha b^N_H}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$
	π^N_L	$\frac{(1-\alpha)E}{n^N_L}\left(1+\frac{n^N_H}{n^N_L}\left(\frac{w^N_H}{w^N_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_H}{b^N_L}\right)^{\frac{\alpha}{1-\alpha}}+\frac{n^S_L}{n^N_L}\alpha^{\frac{\alpha}{1-\alpha}}\right)^{-1}$	$\frac{(1-\alpha)E}{n^N_L}\left(1+\frac{n^N_H}{n^N_L}\alpha^{\frac{\alpha}{1-\alpha}}+\frac{n^S_L}{n^N_L}\left(\frac{w^N_L}{w^N_H}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_L}{b^N_H}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$
	π^S_L	$\frac{(1-\alpha)E}{n^S_L}\left(1+\frac{n^N_L}{n^S_L}\alpha^{\frac{\alpha}{1-\alpha}}+\frac{n^N_H}{n^S_L}\left(\frac{w^N_H}{w^N_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{\alpha b^N_H}{b^N_L}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$	$\frac{(1-\alpha)E}{n^S_L}\left(1+\frac{n^N_L}{n^S_L}\left(\frac{w^N_H}{w^N_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{b^N_H}{b^N_L}\right)^{\frac{\alpha}{1-\alpha}}+\frac{n^N_H}{n^S_L}\left(\frac{w^N_H}{w^N_L}\right)^{\frac{\alpha}{\alpha-1}}\left(\frac{\alpha b^N_H}{b^N_L}\right)^{\frac{\alpha}{1-\alpha}}\right)^{-1}$

Entrepreneurial activity introduces new goods and services into the economy. Product development allows existing products to be produced by low skilled labour in the North and outsourcing moves the production of routinized products to the South. Even if patents are perfectly enforced, such activities are worthwhile, as the flow of profit increases with each stage in the life cycle, as long as $w^{N}{}_{H} > w^{N}{}_{L} > w^{S}{}_{L}$. The incentive to move the product over the cycle then comes from increments in the profit flow. This also explains why incumbents may engage in (defensive) product development and outsourcing even though they cannibalize on their current profits.[11] The incentive to become an innovating entrepreneur is the value of being a Northern uncontested new good producer that is given by:

$$v^{N}{}_{H} = E\left\langle \int_{t}^{T} e^{-r(\tau-t)} \pi^{N}{}_{H}(\tau) d\tau \,\middle|\, I(t) \right\rangle \tag{11}$$

the expected discounted profit flow from time *t*, the time of entry, to time *T*, the time at which production with low skilled labour starts and monopoly profits are contested, conditional on the information set *I*(*t*) available at time *t*. The flow probability of being contested is given by the relative gross number of product development, $\left(\dot{n}^{N}{}_{L} + \dot{n}^{S}{}_{L}\right) / n^{N}{}_{H}$. Expecting that profit grows at a constant rate, as it will in the steady state, yields:

$$v^{N}{}_{H} = \pi^{N}{}_{H}(t) \int_{t}^{\infty} e^{-(r+(\dot{n}^{N}{}_{L}+\dot{n}^{S}{}_{L})/n^{N}{}_{H})(\tau-t)} \pi^{N}{}_{H}(t) e^{(\dot{E}/E-\dot{n}^{N}{}_{H}/n^{N}{}_{H})(\tau-t)} d\tau = \frac{\pi^{N}{}_{H}(t)}{r - \dot{E}/E + \dot{n}/n^{N}{}_{H}} \tag{12}$$

An entrepreneur is able to capture this value by setting up a firm and starting production of a new good or service. Similarly we have for the Northern low skilled producers:

$$v^{N}{}_{L} = \frac{\pi^{N}{}_{L}(t)}{r - \dot{E}/E + (\dot{n}^{S}{}_{L} + \dot{n}^{N}{}_{L})/n^{N}{}_{L}} \tag{13}$$

where the current profits are discounted by the rate of interest, *r*, the rate of profit erosion, $-\left(\dot{E}/E - \dot{n}^{N}{}_{L}/n^{N}{}_{L}\right)$ and the risk of losing the profits because of outsourcing, $\dot{n}^{S}{}_{L}/n^{N}{}_{L}$. However, the value of a product development to the incumbent is lower. In order to obtain the higher profit flow an incumbent foregoes the existing profit flow. Hence the value of a product development equals the positive difference between (13) and (12). Finally the value of owning an outsourced firm that produces in the South is equal to:

$$v^{S}{}_{L} = \frac{\pi^{S}{}_{L}(t)}{r + \psi - \dot{E}/E + \dot{n}^{S}{}_{L}/n^{S}{}_{L}} \tag{14}$$

where ψ is a risk premium for producing abroad that reflects the risks of being unable to retrieve profits and reflects the perhaps less than perfect property rights protection in the South.[12] Once

[11] In fact we assume their cost advantage and tacit knowledge give them a sufficient edge, so we see only incumbent firms doing product development.

[12] This is our parameter for political risk.

more the value to the incumbent and therefore also to any entrant that is forced to compensate him for patent infringement, equals the positive difference between (14) and (13).[13]
Let us finally assume that introducing a new good or service, developing a product and outsourcing it all draw on the same pool of limited resources in the North, which we may label entrepreneurial talent, T.[14] To close the model we must specify how entrepreneurial talent combines with accumulated knowledge to generate the dynamics in the model. Assume:

$$\begin{aligned} \dot{n}^{N}{}_{H} &= \dot{n} - \dot{n}^{N}{}_{L} - \dot{n}^{S}{}_{L} = aT_{I}{}^{\gamma} n^{A} - \dot{n}^{N}{}_{L} - \dot{n}^{S}{}_{L} \\ \dot{n}^{N}{}_{L} &= aT_{D}{}^{\gamma} n^{N}{}_{H} - \dot{n}^{S}{}_{L} \qquad \text{where } 0 \leq \gamma \leq 1 \qquad (15) \\ \dot{n}^{S}{}_{L} &= aT_{O}{}^{\gamma} n^{N}{}_{L} \end{aligned}$$

Note that a productivity parameter a and the amount of entrepreneurial talent allocated are combined with n^{A}, $n^{N}{}_{H}$ and $n^{N}{}_{L}$ to reflect the knowledge spillovers in the model. Innovation benefits from the (exogenous) stock of knowledge, n^{A}.[15] Development benefits from the knowledge accumulated in new goods production, $n^{N}{}_{H}$, and outsourcing benefits from experience in routinized production, $n^{N}{}_{L}$. Furthermore (15) reflects the assumption that a product must first be invented, can then be routinized and finally outsourced, but only in that order, missing none of the stages in its development.

Entrepreneurial talent now has to be allocated over three alternative uses. In each it must generate the same marginal value product. Assuming this (market clearing) reward to entrepreneurial talent is given by w_{T} we obtain:

$$w_{T} = \gamma a T_{I}{}^{\gamma-1} n^{A} v^{N}{}_{H} = \gamma a T_{D}{}^{\gamma-1} n^{N}{}_{H} \left(v^{N}{}_{L} - v^{N}{}_{H} \right) = \gamma a T_{O}{}^{\gamma-1} n^{N}{}_{L} \left(v^{S}{}_{L} - v^{N}{}_{L} \right) \qquad (16)$$

This arbitrage condition can be rewritten in separate entrepreneurial talent demand equations that are downward sloping in the reward for entrepreneurial talent.[16]

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13 Results do not change qualitatively and become stronger if we allow for entrepreneurs to not compensate incumbents. Obviously that makes outsourcing even more attractive.

14 Alternatively one could think of R&D labour, engineering talent, or organizational and managerial talents. All that is required to justify this assumption is that all innovative activities require the same labour that is a different type of labour than that used in production.

15 See Sanders (2005) for more details on how this knowledge parameter can be endogenized. In standard new growth models it is frequently assumed to be equal to n, accumulated innovation. In this model this would also introduce endogenous growth but prevent us from experimenting with shocks to the knowledge stock. The introduction of a new GPT, however, is exactly that, a positive shock to n^{A}.

16 One could consider setting w_{T} equal to the high skilled wage in the North as it arguably presents the opportunity costs for the entrepreneur. However, this complicates the model considerably without adding much in terms of insight in the mechanisms we are primarily interested in. Sanders (2005) shows the equivalence in qualitative results in a different (two stage life cycle) but closely related model.

Equating the sum to the total stock of entrepreneurial talent in the North yields the equilibrium reward for entrepreneurial activity:

$$w_T = aT *^{\gamma-1} n^A v^N{}_H \left(1 + \left(\frac{n^N{}_H}{n^A} \left(\frac{v^N{}_L}{v^N{}_H} - 1 \right) \right)^{\frac{1}{1-\gamma}} + \left(\frac{n^N{}_L}{n^A} \left(\frac{v^S{}_L}{v^N{}_H} - \frac{v^N{}_L}{v^N{}_H} \right) \right)^{\frac{1}{1-\gamma}} \right)^{\gamma(1-\gamma)} \quad (17)$$

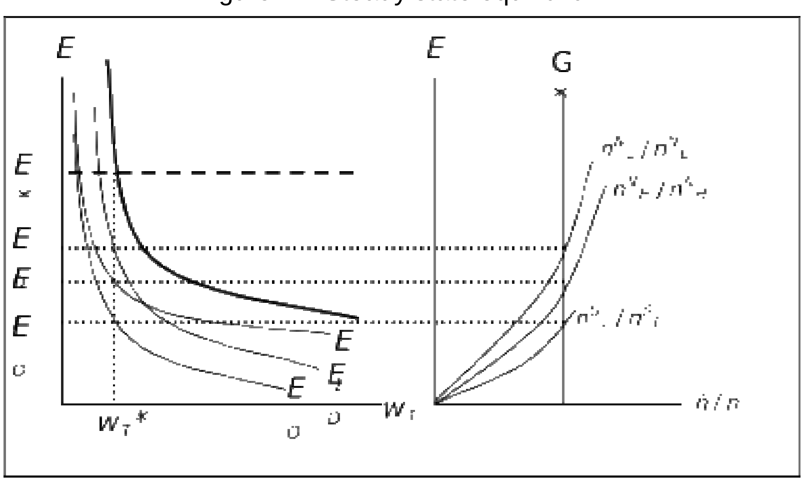
which in steady state grows in proportion to n^A times $v^N{}_H$. As the latter grows in proportion to profits, which in turn grow in proportion to expenditure, E, over $n^N{}_H$ in the steady state the reward to entrepreneurial talent will grow in proportion to total expenditure, as will wages in all labour markets, as long as n^A grows at the same rate as $n^N{}_H$. Normalization of expenditure then pins down the growth rate of all nominal variables in the model to 0. The total range of goods expands at the common growth rate of new, mature, and outsourced goods in the global economy. This leads to propositions I and II.

Proposition I: There exists a steady state equilibrium in which the allocation of all labour types is stable, all ranges of goods grow at the common positive rate and labour markets are clear.

Proposition II: This steady state is a unique and globally stable equilibrium in the sense that the economy will converge back to this steady state when it is disturbed by shocks.

The proof for both propositions is in the Appendix. The dynamic equilibrium in the model can be illustrated by plotting the three demand equations for entrepreneurial activity, implicit in equation (16) and equating the vertical sum of these curves to the exogenous supply of entrepreneurial talent in the North. In the steady state these levels of activity must generate the same rate of expansion G*, to the respective variety ranges. The knowledge spillover structure assumed in equation (15), which implies all entrepreneurial activity receives a spillover from upstream entrepreneurial activity (which for innovation is exogenous knowledge creation), guarantees that in the end all variety ranges will grow at the same rate for a stable allocation of entrepreneurial talent. As was shown under Proposition II and in the Appendix this implies in the steady state the right panel of Figure 11 applies.

Figure 12: Steady state equilibrium



Now consider the comparative statics in the steady state concerning the effects of increases in L^S_L, (globalization/integration), ψ (property rights/institutions) and n^A (technology shock/GPT) and our policy experiment to encourage and stimulate entrepreneurship T^* (education/entrepreneurship). To see what happens consider first the shocks in isolation.
A sufficiently large increase in southern labour supply (if the shock is too small one may stay in a situation of narrow wage gap and relative profits do not change, causing no response) will initially drive down equilibrium wages in the South and push the southern economy out of a possible narrow gap situation. In Table 1 it can be seen that in that case profits in the South will rise as wages fall. By equation (14) that implies the value of outsourcing activities increases and entrepreneurs will switch out of innovation and development to outsource more mature products to the South. As the rate of outsourcing accelerates and the rates of innovation and development fall, there is a change in the relative composition of the economy. More varieties are produced in the South, variety expansion falls and both n^N_H and n^N_L will fall relative to n^S_L. This, by (10) implies that Southern wages recover and Northern wages will fall, whereas the reward to entrepreneurial talent rises. Of course equilibrium is re-established once diminishing returns in innovation, development and outsourcing (through the gradual reduction of upstream knowledge stocks) make sure all ranges grow at the same rate again. It should be noted here that the prediction that Southern wages fall and recover gradually does not apply for the countries that join world markets. They enter the market with wages below w^S_L and see an immediate rise followed by a further increase in the wage level. The predictions for Southern wage levels therefore rather apply to for example countries like Brazil, Mexico, and Egypt than India or China.

The impact of a drop in political risk ψ enters our model directly in the return to outsourcing equation (14). Decreasing risk implies lower discount rates of given profits, making outsourcing more attractive to the entrepreneurs. The impact on the allocation of entrepreneurial talent and the relative composition of the economy is similar as above. However, there is no steady state reduction in Southern wages. Instead the wages rise due to the increased demand. In the North the implications for relative wages and income are similar as before. The entrepreneurs gain and the low skilled lose out most but also high skilled wages fall relative to Southern wages.

A rise in the knowledge stock n^A or the rate of knowledge expansion has a temporary or permanent effect on the steady state composition of the economy, respectively. If there is a level shock the benefits will dissipate gradually. The high skilled workers in the North benefit first. Entrepreneurs move into innovation and abandon development and outsourcing. As the available stock of new products expands, however, the entrepreneurs will return to development and ultimately outsourcing. The steady state has no changes so the economy will eventually return to its initial equilibrium. If the growth rate has increased permanently that implies that in the steady state all ranges of goods will grow at a higher rate, but also that the steady state size of the new product range will be larger. Consequently the high skilled in the North gain relative to the low skilled in North and South and again the entrepreneurs benefit.

A rise in T^* the stock of entrepreneurial talent/resources in the Northern economy, has a peculiar steady state impact in this model. The entrepreneurs will be allocated to expanding the three variety ranges and these ranges and all ranges will therefore expand faster for some time, but as the new and mature goods range are also eroded faster only the range of Southern varieties will

grow in the steady state. That generates the interesting result that the benefits of entrepreneurship training in general leak to developing countries. As entrepreneurs pass the buck, the buck moves faster to where it stops. However, one should realize that in passing the buck the entrepreneur appropriates part of the surplus with every pass. Entrepreneurial output thus increases and even though their wages fall, their incomes rise to the extent that Northern income increases relative to Southern income if demand elasticities are sufficiently low. One should also realize that the North is composed of many countries and any one Northern entrepreneur may take a mature good and outsource it. Having more entrepreneurs and fewer workers in your country puts you in a favorable position relative to the other Northern countries, not in the least because more entrepreneurs also means quicker adjustment to external shocks as the ones described above. From a global perspective more entrepreneurs are also unambiguously beneficial. It will reduce global wage if not income inequality and ensures faster adjustment to equilibrium when exogenous shocks hit the economy. As the world may still have to deal with such shocks in the future, the end of oil reserves, nuclear disaster in the Middle East, the recovery of Japan or the introduction of cold hydrogen fusion reactors. Whatever lays ahead, entrepreneurs can help deal with it and adjust as long as change opens up opportunities.

Finally consider the effect of all shocks described above combined. As we argued in Section 1 that is precisely what happened over the past 25 years. The model then predicts significant wage divergence in the North between the skilled and unskilled and certainly between the entrepreneurs and workers in general, increasing FDI and outsourcing to the South, and a widening of the North-South wage gap. The latter has not been observed in the data as China and India have always been considered part of the South but taking them out of the sample one sees significant divergence between OECD and non-OECD countries in both wage and income levels. China and India, on the other hand, are seen to quickly close the wage and income gap with the North and not surprisingly they receive the bulk of FDI outflow from the North as well. Lower political risk implies that the downward wage pressure in the (rest of) the South is somewhat ameliorated. Our policy experiment of increasing the entrepreneurial capabilities shows that self-interested national policies may yet help to tip the scales and help close the North-South wage and income gaps while offering new perspectives for countries in the North to remain competitive among their peers in globalizing markets.

4 Conclusions

Globalization and technological change have triggered fundamental changes in both the developed and developing countries. This paper illustrates one mechanism through which these shocks interact. By opening up new opportunities for entrepreneurs new technology and a global market both create a dynamic that shifts the specialization pattern in the global economy. An important implication of our model is that developing countries are gaining the comparative advantage for economic activity in the latter stages of the product life cycle, where the classic factors of raw labour and physical capital play an important role. At the same time, globalization has facilitated a shift in comparative advantage in the advanced economies away from mature industries and towards economic activity in the early stage of the product life cycle. This reorientation towards early stage activity was reinforced by the simultaneous rise of a GPT that offers both the means for organizing off-shoring and outsourcing and presented entrepreneurs with many opportunities for new products and services. The coincidence of these trends caused

and forced the advanced countries to enter the entrepreneurial economy, whereas it allowed (some) developing countries to rapidly industrialize. Whether the emergence of the entrepreneurial economy is permanent or transitory depends upon the nature of globalization. It does not seem likely, however, based on the model presented in this paper, to expect a return to the industrial economy any time soon. The political turnaround we have identified as the exogenous shock driving globalization is not likely to be reversed. On the technology side, however, we do know that related new products and services will mature. The plight of the unskilled worker in the advanced economies may yet be ameliorated by his increased participation in these new industries. Under current global competitive conditions, however, it is more likely that these industries will also quickly transfer routine operations to less expensive regions and alternative employment may be required after all.

The policy implications of our analysis are thus that developed countries' governments should gear their labour market and social security policies to the new economic reality. Flexibility, mobility, and employability are key assets for workers and self-employed in the entrepreneurial economy. A large and easily accessible low skilled non-tradables sector such as personal services would have to be developed if welfare states are to survive this pressure.

For the developing world the focus should gradually shift from attracting FDI inflows to building local capabilities and absorbing mature technologies. In the end, the transition to a developed country is possible, but to take-off a strategy of gradually moving upstream in the life cycles seems appropriate. Modern growth theory has little to offer for the situation they find themselves in. More R&D will not help regions and countries in which not even mature routine industrial activity has been developed. But governments should also realize that comparative and competitive advantages are temporary in nature and should not be protected against such dynamics. Stimulating local entrepreneurs to take advantage of the opportunities in global markets is the one policy that can be shown to deliver lasting advantages as, by their flexibility, these entrepreneurs can help adapt to possible future shocks as well as the current slump in global economic growth.

Our model does not generate very detailed policy advice for either side but the general direction is clear and further research requires a fundamental understanding of these macroprocesses. In that understanding we hope to have contributed.

Appendix

Proof of Proposition I

The proof follows from assuming this steady state exists and showing that it constitutes an equilibrium in all labour markets. First consider the markets for production labour. They clear iff the allocation satifies:

$$L^{N}{}_{H}* = n^{N}{}_{H}\alpha^{\frac{1}{1-\alpha}}b^{\frac{\alpha}{1-\alpha}}EP^{\frac{\alpha}{1-\alpha}}\left(w^{N}{}_{H}\right)^{\frac{1}{\alpha-1}}$$

$$L^{N}{}_{L}* = n^{N}{}_{L}b^{-1}EP^{\frac{\alpha}{1-\alpha}}\left(\min\left[\frac{w^{N}{}_{H}}{b},\frac{w^{N}{}_{L}}{\alpha b}\right]\right)^{\frac{1}{\alpha-1}} = n^{N}{}_{L}b^{\frac{\alpha}{1-\alpha}}EP^{\frac{\alpha}{1-\alpha}}\left(\min\left[\frac{w^{N}{}_{H}}{w^{N}{}_{L}},\frac{1}{\alpha}\right]\right)^{\frac{1}{\alpha-1}}\left(w^{N}{}_{L}\right)^{\frac{1}{\alpha-1}}$$

$$L^{N}{}_{H}* = n^{S}{}_{L}b^{-1}EP^{\frac{\alpha}{1-\alpha}}\left(\min\left[\frac{w^{N}{}_{L}}{b},\frac{w^{S}{}_{L}}{\alpha b}\right]\right)^{\frac{1}{\alpha-1}} = n^{S}{}_{L}b^{\frac{\alpha}{1-\alpha}}EP^{\frac{\alpha}{1-\alpha}}\left(\min\left[\frac{w^{N}{}_{L}}{w^{S}{}_{L}},\frac{1}{\alpha}\right]\right)^{\frac{1}{\alpha-1}}\left(w^{S}{}_{L}\right)^{\frac{1}{\alpha-1}}$$

(A1)

Taking growth rates on both sides implies:

$$\begin{aligned}
0 &= \frac{\dot{n}^{N}{}_{H}}{n^{N}{}_{H}} + \frac{\dot{E}}{E} + \frac{\alpha}{1-\alpha}\frac{\dot{P}}{P} + \frac{1}{\alpha-1}\frac{\dot{w}^{N}{}_{H}}{w^{N}{}_{H}} \\
0 &= \frac{\dot{n}^{N}{}_{L}}{n^{N}{}_{L}} + \frac{\dot{E}}{E} + \frac{\alpha}{1-\alpha}\frac{\dot{P}}{P} + \frac{1}{\alpha-1}\frac{\dot{w}^{N}{}_{L}}{w^{N}{}_{L}} \\
0 &= \frac{\dot{n}^{S}{}_{L}}{n^{S}{}_{L}} + \frac{\dot{E}}{E} + \frac{\alpha}{1-\alpha}\frac{\dot{P}}{P} + \frac{1}{\alpha-1}\frac{\dot{w}^{S}{}_{L}}{w^{S}{}_{L}} \\
\frac{\dot{w}^{S}{}_{L}}{w^{S}{}_{L}} &= \frac{\dot{w}^{N}{}_{L}}{w^{N}{}_{L}} = \frac{\dot{w}^{N}{}_{H}}{w^{N}{}_{H}}
\end{aligned} \qquad \text{(A2)}$$

where the latter constraints follows from the fact that relative wages appear in the expressions. From these conditions we can derive that in any steady state equilibrium wages must grow at the same rate and hence so must all sectors. This in turn implies in (15) that the number of firms in each sector must grow at the same constant rate as n^{A}.

Now consider the market for entrepreneurial talent. It clears when (17) holds. Under the conditions derived above, the reward to entrepreneurship can be shown to grow at rate:

$$\frac{\dot{w}_{T}}{w_{T}} = \frac{\dot{n}^{A}}{n^{A}} + \frac{\dot{v}^{N}{}_{H}}{v^{N}{}_{H}} = \frac{\dot{n}^{A}}{n^{A}} + \frac{\dot{\pi}^{N}{}_{H}}{\pi^{N}{}_{H}} = \frac{\dot{n}^{A}}{n^{A}} + \frac{\dot{E}}{E} - \frac{\dot{n}^{N}{}_{H}}{\dot{n}^{N}{}_{H}} = \frac{\dot{E}}{E} \qquad \text{(A3)}$$

This implies that, if relative wages are to be constant, all must grow at the same rate as total expenditures and (A2) reduces to:

$$0 = g + \frac{\alpha}{1-\alpha}\frac{\dot{P}}{P} + \frac{\alpha}{\alpha-1}\frac{\dot{E}}{E} \qquad \text{(A4)}$$

If we then normalize expenditure to 1 growth rates of profits and consequently innovation values reduce to $-g$ and the interest rate is endogenously determined by (2) to equal ρ. There is therefore a steady state equilibrium that is fully characterized by:

$$\frac{\dot{n}^A}{n^A} = \frac{\dot{n}^N{}_H}{n^N{}_H} = \frac{\dot{n}^N{}_L}{n^N{}_L} = \frac{\dot{n}^S{}_L}{n^S{}_L} = -\frac{\dot{\pi}^N{}_H}{\pi^N{}_H} = -\frac{\dot{\pi}^N{}_L}{\pi^N{}_L} = -\frac{\dot{\pi}^S{}_L}{\pi^S{}_L} = -\frac{\dot{v}^N{}_H}{v^N{}_H} = -\frac{\dot{v}^N{}_L}{v^N{}_L} = -\frac{\dot{v}^S{}_L}{v^S{}_L} = g$$

$$\frac{\dot{E}}{E} = \frac{\dot{w}^N{}_H}{w^N{}_H} = \frac{\dot{w}^N{}_L}{w^N{}_L} = \frac{\dot{w}^S{}_L}{w^S{}_L} = \frac{\dot{w}_T}{w_T} = r - \rho = 0$$

$$\frac{\dot{P}}{P} = \frac{\alpha - 1}{\alpha} g \qquad \text{(A5)}$$

Q.E.D.

Proof of Proposition II

Consider being out of equilibrium such that $n^N{}_H/n^N{}_L > (n^N{}_H/n^N{}_L)^{SS}$. Then by Table 1 $\pi^N{}_H/\pi^N{}_L < (\pi^N{}_H/\pi^N{}_L)^{SS}$ and consequently by (12)–(13) $v^N{}_H/v^N{}_L < (v^N{}_H/v^N{}_L)^{SS}$ which implies that $T_I < T_I^{SS}$ and $T_D > T_D^{SS}$ such that $\dot{n}^N{}_H / n^N{}_H < g$ and $\dot{n}^N{}_L / n^N{}_L < g$. Therefore we move towards the equilibrium as (15) then implies that $n^N{}_H/n^N{}_L$ falls towards $(n^N{}_H/n^N{}_L)^{SS}$. That process will end in the steady state. A similar argument can be made for all possible deviations from the steady state allocation of entrepreneurial activity, which proves that the steady state is both unique and stable.

Q.E.D.

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