



UNITED NATIONS  
UNIVERSITY

UNU-WIDER

World Institute for Development  
Economics Research

Working Paper No. 2010/57

## Entrepreneurship, Structural Change and a Global Economic Crisis

Thomas Gries<sup>1</sup> and Wim Naudé<sup>2</sup>

May 2010

### Abstract

Building on a Lewis-type model of structural change and entrepreneurship we show how a global economic crisis consisting of a financial and a trade shock can undermine structural change in developing countries via the start-up and innovation activities of entrepreneurs. The model analytics identifies a number of challenges for structural change in a post-crisis world, including dealing with greater bank concentration, higher costs of bank monitoring and stricter regulations and collateral requirements, flights-to-safety in global finance and reduced incentives for innovation and job-creating start-up activities.

Keywords: entrepreneurship, global economic crisis, structural change

JEL classification: M13, L26, O10, O14

Copyright © UNU-WIDER 2010

<sup>1</sup> University of Paderborn, Department of Economics, email: thomas.gries@notes.upb.de,

<sup>2</sup> UNU-WIDER, email: Wim@wider.unu.edu

This study has been prepared within the UNU-WIDER project on Entrepreneurship and Development (Promoting Entrepreneurial Capacity), directed by Wim Naudé.

UNU-WIDER gratefully acknowledges the financial contributions to the project by the Finnish Ministry for Foreign Affairs, and the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Finnish Ministry for Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

ISSN 1798-7237

ISBN 978-92-9230-294-8

*The World Institute for Development Economics Research (WIDER) was established by the United Nations University (UNU) as its first research and training centre and started work in Helsinki, Finland in 1985. The Institute undertakes applied research and policy analysis on structural changes affecting the developing and transitional economies, provides a forum for the advocacy of policies leading to robust, equitable and environmentally sustainable growth, and promotes capacity strengthening and training in the field of economic and social policy making. Work is carried out by staff researchers and visiting scholars in Helsinki and through networks of collaborating scholars and institutions around the world.*

*[www.wider.unu.edu](http://www.wider.unu.edu)*

*[publications@wider.unu.edu](mailto:publications@wider.unu.edu)*

UNU World Institute for Development Economics Research (UNU-WIDER)  
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by the authors.

The views expressed in this publication are those of the author(s). Publication does not imply endorsement by the Institute or the United Nations University, nor by the programme/project sponsors, of any of the views expressed.

# 1 Introduction

Overcoming global disparities in incomes and wealth requires that lagging countries successful pass through the process of structural change from being rural, agriculturally dominated economies to more urbanized, manufacturing and service sector based economies (Lewis, 1954). Such structural change is a stylized fact of economic development (Chenery 1960; Kuznets 1966; Syrquin 1988), and is required for productivity growth – the determinant of most of the differences in incomes across countries (Gorodnichenko and Schnitzer, 2010).

A global economic crisis, such as the most recent 2008-2009 crisis, can affect the dynamics of structural change and hence maintain or even widen global disparities. A key channel is the behaviour of entrepreneurs during and after a crisis.<sup>1</sup>In recent years the previously neglected topic of entrepreneurship in economic development has experienced a modest resurgence (see e.g. Acs et al., 2008; Acs and Szerb, 2009; Amorós et al., 2010; Gries and Naudé, 2009; Minniti and Naudé, 2010; Naudé, 2007, 2008, 2009a, 2010a, 2010d, 2010e, Naudé et al., 2008). Herein it is increasingly realized that the role of entrepreneurship differs across different stages of a country's development, and that the interaction between a country's institutions and its entrepreneurs is an important factor determining the country's economic performance. Gries and Naudé (2010) for instance provide a closed-economy model of structural change based on the Lewis-model to illustrate that institutional weaknesses can create frictions in the process where start-up opportunities are matched with entrepreneurial talent.

In this paper we extend Gries and Naudé's (2010) model to an open economy setting so as to study the impacts of a global economic crisis on structural change in a developing country. There is general agreement that the global economic crisis which erupted in 2008 in the US's sub-prime mortgage and soon lead to the most dramatic contraction in world trade since the Second World War, impacted on developing countries through a contraction in financial markets and a reduction in export demand (trade)(Naudé, 2009b; 2009c; 2010b). A growing literature has by now been devoted to this most recent of global economic crises. It has focused on the causes of the crisis (Barth, 2008; Felton and Reinhart, 2008; Johnson, 2009; Ritholtz, 2009; Stiglitz, 2009; Taylor, 2009), the remedies (Claessens, 2009; Freedman et al., 2009; Ravallion, 2008;) and the impacts (Friedman and Schady, 2009; Heady et al., 2009; Naudé, 2009,2010b). There are still a number of gaps in the literature in terms of providing a comprehensive understanding of the crisis. One is that the current literature is predominantly empirical, focusing on trends, costs, magnitudes of impacts and forecasts of recovery. So far much less work has gone into broadening our theoretical conceptualization of the crisis vis-à-vis economic growth and change. A second gap is that the relationship between entrepreneurship and the crisis has been relatively neglected. Only a few papers have so far dealt with the fact that a very important manifestation of the crisis is to be found in the churning of

---

<sup>1</sup>Entrepreneurial behaviour can also cause or contribute to a global economic crisis. Such destructive entrepreneurship is not dealt with here but is left as a potential topic for a future paper.

firms-the failure of existing firms and the creation of new firms (e.g. Koellinger and Thurik, 2009; Naudé and McGee, 2009; OECD, 2009). Even though the crisis is now receding, the sudden changes caused in the nature and mix of surviving and new entrepreneurs may have long-term impacts (Kedrosky, 2008; Naudé and McGee, 2009; OECD, 2009 Naudé, 2010f). Moreover, how these will affect structural change and global disparities to come is still a relatively unexplored topic.

Our paper, by formalizing the relationship between entrepreneurship, structural change and a global economic crisis therefore aims to contribute towards these current gaps in the literature. The remainder of the paper will proceed as follows. In section 2 we describe the salient features (or stylized facts) of the most recent global economic crisis. We discuss how these may impact on entrepreneurship, structural change and poverty. In section 3 we provide an open-economy endogenous growth model to enable us to analyse the impact of a global economic crisis on a developing country's structural change through entrepreneurial start-ups and innovation. In section 4 we first use the model in a closed economy context to illustrate how a domestic financial crisis will slow down start-up and innovation rates and structural change. We also show how even in the absence of financial integration there can be financial contagion effects from an advanced economy crisis to a closed developing country. Then in section 5 we use the open economy version of the model to derive a number of comparative static effects to study the impact and implications of a global economic crisis. Section 6 concludes.

## 2 Global Economic Crisis

### 2.1 Description and Salient Features

As was mentioned the 2008-2009 global economic crisis resulted in both a financial and trade shock to the world economy. The financial shock emanated from the collapse on 15 September 2008 of the investment banking firm Lehman Brothers - with assets of US\$639 billion the largest bankruptcy to date in the history of the US. Lehman's collapse was the outcome of an unsustainable bubble in US house prices which, in the absence of appropriate prudential regulation and the illusion of perpetual price rises, resulted in the extension of mortgage finance to households with little prospects of repaying their loans ('sub-prime' mortgages) (Naudé, 2010b). Between 2004 and 2006 these accounted for 25 per cent of new US mortgages (Kay, 2008) amounting to more than US\$1.3 trillion (Lin, 2008). Banks covered up the risk by securitizing the expected income streams from these bad loans, packaging them in with other securities such as Collateralized Debt Obligations (CDOs). These were easily sold throughout the world as they were given favourable (AAA) ratings by Credit Rating Agencies. However by early 2007 problems started with growing mortgage defaults, foreclosures and rising short-term interest rates. By mid 2008 around 40 per cent of all sub-prime mortgages issued in 2006 were non-performing (UN, 2009). The

subsequent deflation of a house price bubble and consequently reduced confidence in the US dollar contributed to a rise in energy and food prices (Khan, 2009). Oil and maize prices peaked in July 2008 at record levels, putting enormous economic strain on energy and food importing developing countries (UN, 2009). By September 2008 the sub-prime crisis had become systemic and following the collapse of Lehman widespread panic resulted in financial markets. Weakened stock markets crashed and uncertainty about bank solvencies lead to a global credit contraction. Losses in wealth, consumer confidence and dwindling trade finance was soon followed by the news that the US, and most other advanced economies, were in recession. It would lead in 2009 to the first contraction in global trade (of around -11 percent) since the Second World War. Developing countries, most of whom had experienced robust growth since 2000, all suffered significant declines in economic growth in 2008-2009, contributing to rising unemployment and poverty (Naudé, 2010f).

The sub-prime financial crisis in the US was not the first financial crisis with global repercussions (Laeven and Valencia, 2008). Indeed, as Claessens (2009: 3) notes the recent crisis' main features are very similar to that of previous crises, such as (i) the blowing up of an unsustainable asset price bubble – in the recent case particularly in house prices, and later in energy and food prices, (ii) a credit boom leading to unmanageable debt burdens – in the recent case in the sub-prime mortgage market in particular, (iii) an increase in marginal loans and systemic risks, which was made worse in the recent case by the way sub-prime mortgages were packaged and sold throughout the global financial system, and (iv) a failure of regulation and supervision – in the recent case witnessed by the rise of the financial sector, particularly of 'shadow banking', its growing political power and influence over government in the US, and the various moral hazards this created (Johnson, 2009; Stiglitz, 2009; Taibbi, 2009).

The responses of advanced (and some developing) economies to the crisis have been unprecedented. Whereas the sudden onset and depth of this crisis is in many ways similar to that of the Great Depression of the 1930s, it differs in the extent of the response, as a result of which short-term recovery was already evident by the end of 2009. Fearing another Great Depression (1929-33) advanced economies applied all the lessons learned from that crisis by bailing out banks (most were allowed to fail during the Great Depression) and announcing huge fiscal stimuli (only monetary policy were attempted during the Great Depression). By 2010 recovery in most of the developing and advanced economies was underway.

Having described the outlines of the 2008-09 crisis, a number of its salient features can now be highlighted for purposes of this paper.

The first is to note that the global integration of financial markets, and the increased financial liberalization in which many countries have engaged in over the past decade, lead to a rapid transmission of the sub-prime crisis across the world – causing credit contractions all round. Amongst developing and emerging country regions the worst to be affected were the transition countries of Eastern Europe and Central Asia. Countries with less globally integrated financial systems seemed to be less affected. Hence the IMF (2009: 27) pointed out that

African countries have had much fewer incidences of banks experiencing difficulties due to ‘the still limited though increasing integration with global financial markets, minimal exposure to complex financial instruments, relatively high bank liquidity, limited reliance on foreign funding, and low leverage in financial institutions’. However, even in such less integrated economies the US-centred financial crisis had an impact-many banks in Africa were reminded that the US-crisis was due (partly) to inadequate bank supervision and capital requirements, and subsequent to the outbreak their surveillance and supervision was tightened, hence reducing the availability of credit in their domestic economies (Naudé, 2010c). This impact of contagion even on relatively financially isolated economies will be further explored in our model in section 4 below.

Second, the financial crisis itself was manifested in a sudden reduction in financial wealth as stock and housing markets collapsed. It has been estimated that between September and October 2008 an estimated US\$25 trillion in wealth was wiped from stock markets alone. According to Loser (2009) currency depreciations, declines in stock prices, losses in the value of private and public debt and the effects of depreciations on deposits could result in losses of more than US\$ 9 trillion in Emerging Asia and the newly industrialized countries over 2009-an amount equivalent to 109 per cent of these regions’ GDP.

Third, all countries – particularly in the West but also in the developing world – incurred a huge cost in order to stabilize their financial systems. According to IMF estimates, the costs of stabilizing banks, in terms of injections of capital (bailouts), provision of liquidity, standby arrangements, and guarantees of loans and deposits, amounted to around US\$11 trillion in developed countries, and US\$1.7 trillion in developing countries<sup>2</sup>. This has diverted funding from other, perhaps more long-term uses, and has raised the spectre of unsustainable accumulation of government debt across a range of countries.

Fourth, there was a paradoxical flight to safety of funds towards the epicenter of the crisis, namely to banks in the US and Europe, as a result of bailouts and guaranteed bank deposits. Hence the credit crunch experienced by many developing countries intensified.

Fifth, the general uncertainty prevalent at the beginning of 2009 and the contractions in most developing country stock markets (of between 30 and 60 percent) lead to the costs of developing country government sovereign bond issues soaring-as witnessed by the sharp increase in emerging market bond spreads after September 2008.

Sixth, as advanced economies entered recession, their demand for developing countries exports declined precipitously – and was worsened by contractions in trade credit. The World Bank’s forecasted contractions in exports from developing regions in their June 2009 Global Economic Prospects imply an export revenue loss to developing countries of around US\$397 billion in 2009.

Seventh, reductions in advanced country GDP and trade, and the outflow of funds to developing countries was exacerbated by reductions in FDI, ODA

---

<sup>2</sup>This is a huge sum for developing countries – about ten times the annual flow of Official Development Assistance (ODA) from OECD DAC members in 2008.

and remittances to developing countries. For many or the poorest countries these are important sources of finance, including finance for starting firms and covering working capital requirements. UNCTAD (2009) estimated that FDI to developing countries dropped around 25 percent, even more in transition countries where FDI has been estimated to have declined by up to 40 percent. The World Bank calculated that remittances to developing countries would decline around 7.3 per cent in 2009, implying a loss of US\$24 billion. And according to the EC (2009) total ODA could fall by as much as US\$22 billion in 2009.

Eight, whereas the credit crunch, uncertainty and more expensive debt reduced the general availability of credit in developing countries and raised its cost, the expansionary monetary and fiscal policies used in the advanced economies, and which few developing countries could match, led to a quicker recovery in advanced economies, and for a return to easier credit for entrepreneurs in these economies.

Finally, concentration in the banking industry in countries particularly affected by the global financial crunch—mainly as a result of smaller banks failing but also due to larger banks being bailed out (being ‘too big to fail’). Within a year after the collapse of Lehman Brothers in September 2008, the biggest banks before the crisis (many of whom required substantial bailout money) have become even bigger. Bank of America, J.P. Morgan Chase and Wells Fargo saw asset growth of respectively 138 per cent, 51 per cent and 43 per cent between June 2007 and March 2009. They are also finding it much easier to borrow than smaller banks. By the end of 2009 banks with assets in excess of US\$100 billion were able to borrow at interest rates 0.34 percentage points lower than other banks, while before the crisis the difference was only 0.08 percentage points (Cho, 2009). The problem of concentration in the banking industry is compounded by the similar concentration in related financial services which should provide checks and balances. Thus ‘the analytical foundation for much of the global financial system is now built on the paid-for opinions of just seven firms – the big three Rating Agencies and the Big Four Accounting firms’ (Ely, 2009:97).

## 2.2 Impact on Entrepreneurship and Disparities

What do these nine salient features of the global economic crisis imply for entrepreneurship, particularly in the comparative developing country-advanced country context?

At the outset it is important to note the importance of finance (credit) for entrepreneurship. The general contraction in finance accompanying the global economic crisis will therefore, *ceteris paribus*, lead to a reduction in new firm start-ups, higher rates of firm failure, and slower growth, less investment and employment, and productivity changes for existing firms. Economic theory and empirical evidence support these expected effects of a financial contraction (Banerjee and Newman, 1993; Cagetti and De Nardi, 2005a, 2005b; Evans and Jovanovic, 1989; Gries and Naudé, 2008; Naudé et al., 2008). These effects have indeed also been documented in the case of the 2008-2009 global economic crisis. For instance in the UK the amount raised by venture capital funds fell

from GBP1,010 million in 2006 to GBP179 in 2008 and in the USA the number of business bankruptcies increased by 54 percent in 2008 (OECD, 2009). Not only will fewer firms be started up as a result of lack of access to finance, but wealth inequalities will also worsen because only those individuals with access to own wealth (and firms with sufficient internal finance) will be able to obtain start-up finance. Hence the rich will be more able than say middle-class prospective entrepreneurs to start a firm during a financial crisis (Naudé and MacGee, 2009). This itself can worsen wealth inequalities which in turn can further reduce start-ups – as Mesnard and Ravallion (2005: 3) point out ‘greater wealth equality implies that fewer potential entrepreneurs are able to finance start-up capital’. Thus, more binding credit constraints reduce the start-up rate, lead to reductions in the average size of firms, and increase wealth inequalities.

Access to international markets – affected by export demand and credit costs and availability – is an important determinant of international entrepreneurship. International entrepreneurship refers to the ‘discovery, enactment, evaluation, and exploitation of opportunities-across national borders-to create future goods and services’ (Oviatt and McDougall, 2005: 540). An important feature of globalization has been the rise of international new ventures (INVs), which are firms that internationalize early after their establishment (Naudé and Rossouw, 2010). These firms have also been described as born-globals (McDougall and Oviatt 2003: 9 ). To the extent that a global economic crisis disrupts world trade, ignites protectionist measures, and a retreat from globalization, it would be detrimental to international entrepreneurship and specifically INVs. But it is also existing international entrepreneurs that will be particularly hard hit, especially since the fixed or sunk cost to start exporting is high, and in the absence of sustainable markets and trade credit many entrepreneurs will be forced out of international trade. International sources of finance are important for the start-up and growth of entrepreneurial firms in international trade, as this provides funding that may not otherwise be available to produce for the domestic market. Hence negative shocks to world trade-and world wealth-will be particularly detrimental to international entrepreneurs in developing countries.

The effects of a financial and trade contraction described in the previous paragraphs may be general – affecting entrepreneurs in both developing and advanced economies. However, due to the different nature and role of entrepreneurship across the various stages of a country’s development, a financial and trade contraction due to a global economic crisis could also have a further round of effects that is more subtle, but still important as it will impact on structural change and global disparities.

A key difference between entrepreneurship in developing and advanced economies is that in a developing (lagging) country or region, entrepreneurs are essentially imitators when they introduce goods, services or markets that are new to the economy (or firm) but not to the world (Szirmai, et al., 2010). Essentially they adopt or absorb technologies from leading countries’ innovative entrepreneurs (who operate at the world production frontier). Audretsch and Sanders (2010) show how globalization has through global outsourcing contributed to this transfer or know-how through entrepreneurial behaviour. A financial crunch will



negatively impact on both the ability of entrepreneurs in advanced countries to innovate, as they substitute internal finance towards working capital purposes. For instance the OECD (2009) reports that international patent filings fell from an average growth of 9.3 percent between 2004 and 2007 to only 2.4 percent in 2008. A financial crunch will also limit their ability, through expansion into foreign markets, to transfer new innovations. It is most often medium-sized (middle class) entrepreneurs that innovate; the rich and the super-rich tend to be less into innovative activities. If a financial crisis / sub-prime crisis affects the wealth (and thus start-up potential) of middle class entrepreneurs more proportionately, this will further acerbated the pool of low-innovation firms in advanced countries (Naudé and McGee, 2009).

In developing countries, entrepreneurs (particularly indigenous entrepreneurs) tend to be found predominantly in small-and-medium sized firms, for whom engaging in international trade is a risky and costly, but also potentially rewarding, endeavor. More and more small and young firms in developing countries have been internationalizing at an early age in recent years (Naudé and Rossouw, 2010). A credit crunch and decline in export demand associated with a global economic crisis will therefore potentially squeeze these international entrepreneurs from both demand and supply side. Because growth and public revenue in developing countries tend to be more export-driven or dependent than in many developed countries with larger internal markets, such a global shock will lead to a disproportionately negative impact on entrepreneurial start-ups, international entrepreneurship and entrepreneurial innovation in developing countries (a major reason for entrepreneurs to absorb innovations is to be able to compete internationally and with international firms – a global shock removes this incentive).

If, in addition to these, advanced economies are quicker to provide relief in the form of expansionary monetary and fiscal policies, entrepreneurs in these countries could more quickly recover, with less permanent effects, than in developing countries, where the constraints may bind for a much longer time.

Given, as we illustrate in greater detail in the next section, that entrepreneurs in developing countries are also different in that they have an important role in fostering structural change, then the implication of the aforementioned is that a global economic crisis could be expected to lead to a reduction in innovative entrepreneurial activity in developing countries, in stagnation in low-productivity activities, and a failure to structurally transform and catch-up. Global disparities may be exacerbated.

## 3 Open-Economy Endogenous Growth Model with Entrepreneurship and Finance

### 3.1 Intuitive explanation

In what follows we present a highly stylized and abstract model of a developing economy consisting of a traditional (low productivity) sector, a modern sector, and an (modern) international sector. In the modern sector there are a number of large, established firms (perhaps state-owned) run by mature manager-entrepreneurs. They produce a final output for the domestic market, making use of human capital and intermediate inputs. The intermediate inputs are produced by small firms, and the outsourcing opportunities provided by the large established firms provide opportunities for new entrepreneurial start-ups. These opportunities, each one unique, can be taken up by surplus labour in the traditional sector. When taken up, a new firm is created that supplies an innovative new product (new to the firm and to the country, but not necessarily new to the world) and provides employment opportunities to surplus labour from the traditional sector. In this way, structural change from traditional to modern sector is facilitated through innovation by entrepreneurs. When starting up a new firm to provide an innovative intermediate product in response to an opportunity in the modern sector, the prospective entrepreneur needs finance. This is provided by imperfect financial markets.

In addition to a modern and traditional sector we also have an international sector. This is simply modelling as being separate from the modern domestic sector. Here international entrepreneurs utilize global opportunities for exporting by using inputs sourced from across the world – they are part of global supply chains (global outsourcing or fragmentation). To utilise a start-up opportunity for exports in this sector requires finance – as in the domestic modern sector. In this case, finance is obtained from international capital flows – portfolio flows, FDI, remittances and even aid.

Assuming that the international sector is essentially an enclave and that exporting requires foreign financial flows, we can expose this economy's trade fully to global economic crisis, but also retain the relative isolation of parts of the domestic economy from international markets – a feature of underdevelopment, but also one which leaves less developed economies less vulnerable to international financial flow and trade disruptions (Ravallion, 2008). A financial crisis will result in entrepreneurial activities in the international sector being affected through a reduction in credit, in an increase in reporting and monitoring costs, an increase in collateral requirements, an increase in uncertainty of firm survival, increasing export elasticity due to increasing competition and changes in the world risk free interest rate. Contagion from the international to the domestic sector can occur when banks in the domestic sector become more conservative and cautious in their own lending practices as a result of the crisis affecting the international sector.

Finally, our model has an endogenous growth setting which means that we

look at shocks upon long-term dynamic processes. With this we can distinguish between long-term growth effects and short-term instantaneous adjustment effects-as we do in sections 4 and 5.

Having described the salient features of our model intuitively, in the remainder of this section we provide a formalization starting with the modern domestic sector.

## 3.2 Modern Domestic Sector

### 3.2.1 Final Domestic Good Production

In the modern sector of our economy there are at any given point in time a number  $N_y$  of small entrepreneurial firms. Each produces a specific and differentiated good or service as intermediate inputs for large firms in the final output sector. The latter produces aggregate final output  $Y$  for the domestic market. These large final-good producing firms are owned by domestic oriented mature (established) entrepreneurs. Mature entrepreneurs produce with their entrepreneurial and organizational human capital  $H$  and  $N_y$  intermediate inputs  $y_j$  outsourced to the  $N_y$  small supplying firms. Because we place the emphasis on start-ups and obstacles to their growth, the final good industry of the modern sector is modelled rather simply. Specifically, we propose a continuum of final good producing firms supplying to a competitive final goods market. This feature may not reflect reality in many developing countries where markets may not be that competitive. We leave the introduction of oligopolistic final goods markets for a future extension and for now try to keep the exposition as simple as possible. The production function<sup>3</sup> for the representative final product producing firms<sup>4</sup> can be written as

$$Y = H^{1-\alpha} \sum_{j=1}^N (x_j)^\alpha = H^{1-\alpha} N_y y^\alpha \quad (1)$$

Mature entrepreneurs producing the final good maximize profits according to the profit function  $\pi_Y = Y - w_H H - N_y p_j y_j$  with  $p_j$  denoting the price of intermediate service  $y_j$  and  $w_H$  denoting the income compensation for the entrepreneurial and organizational abilities of the mature entrepreneur. In this model the mature entrepreneur is an organizer of production processes, more a manager, than a risk-taker or innovator. For simplicity we also assume the market for entrepreneurial human capital to be competitive. Using the first order conditions and normalizing  $H$  to one we can derive the demand for each intermediate (service) input, namely

---

<sup>3</sup>This specification of a production function originates from Ethier (1982). Similarly, Romer (1987,1990) used this specification to model technological change and growth, driven by newly invented variations of productive inputs.

<sup>4</sup>Growth is driven by an expansion in  $N$ , denoting the number of small firms in the market and hence the number of different intermediate goods available.

$$y_j = \left( \frac{\alpha}{p_j} \right)^{\frac{1}{1-\alpha}} \quad (2)$$

The human capital wage rate is obtained from the first order condition for labour

$$w_H = (1 - \alpha)Y$$

### 3.2.2 Households in the Modern Sector and Domestic Capital Accumulation

Only households connected to modern final goods production will be able to make explicit intertemporal decisions about savings and investments. Households in the traditional sector and new start-up firms in the modern sector are not able to save. The representative household in the modern sector owns the modern sector firm and receives rental income from entrepreneurial activities  $w_H$  and accumulated wealth. A household's deposits are its only capital asset. Thus aggregate capital income flow consists of interest income from deposits, denoted  $Dr^d$ . The budget constraint can therefore be written as

$$Dr^d + w_H = C + S = C + \dot{D}$$

This shows that total income can be consumed or saved in the form of deposits.

The intertemporal household decision problem is standard. The representative household maximizes a utility function with constant relative risk aversion. The objective function is

$$\max_{C(t)} U(C(t)) = \int_0^{\infty} U(C(t)) e^{-\rho t} dt$$

Here  $\rho$  is the rate of time preference. We assume a constant intertemporal elasticity of substitution (CIES) utility function, i.e.  $u'(c) > 0$ ,  $u''(c) < 0$ , with  $\Theta \equiv -u''(c)c/u'(c)$  denoting the constant relative risk aversion or the reciprocal of the intertemporal elasticity of substitution. Optimization results in the Ramsey rule

$$\frac{\dot{C}}{C} = \frac{r^d - \rho}{\Theta} \quad (3)$$

Here  $\gamma_C$  is the growth rate of consumption. In case of the CIES utility function, the semi-elasticity of deposits is constant and equal to the intertemporal elasticity of substitution  $\frac{\partial D}{\partial r^d} \frac{1}{D} = \frac{1}{\Theta}$ . As the rate of start-ups determines income growth in the production process, the household can achieve the desired growth rate by financing start-ups in the required way. Therefore,

$$\frac{\dot{N}_y}{N_y} = \frac{\dot{C}}{C} \quad (4)$$

### 3.2.3 Entrepreneurial Start-ups in the Domestic Sector

Entrepreneurs are individuals who recognize new opportunities, as described by Kirzner (1973) and Schultz (1975). In the present case, they may recognize opportunities in the modern sector to produce new variants of services or intermediate inputs to large final-goods producing firms. Each product or service variation has certain properties that make the variation unique compared to other already existing variations implying that the utilization of opportunities requires some kind of innovation.

***Start-up ideas and matching of business opportunities.*** In the modern sector there are opportunities for successful firm start-ups. Potential entrepreneurs need to be able to perceive these opportunities, and be willing to try and exploit them. This depends on their entrepreneurial ability, including as we pointed out, their ability to innovate. With these start-up product profiles a new start-up firm may match the requirements and conditions in the modern sector market.

***Start-Up of firms.*** In order to get the new service or product to the market, an entrepreneurial venture, or start-up firm, needs to be created. This is however, subject to start-up costs, which include costs such as initial capital endowment information and organization and management costs, administrative costs, costs of learning, cost of acquiring and developing a business idea (the innovation) and a business plan suitable to obtain finance. Start-up costs are denoted by  $\chi_y$ . As we model start-up firms as supplying differentiated product variations their start-up is by construction an entrepreneurial innovation with respect to the considered economy.

***Operating the new firm.*** In addition to start-up costs there are recurring costs to operate the business. These costs are denoted by  $c_y$  as costs per unit output of the intermediate good. It has two components. First, there are costs related to the specific start-up firm  $\bar{c}_y$  and labour cost. If the entrepreneur employs labour at the given subsistence wage level  $\bar{w}_T$  and the labour coefficient is  $a_y = \frac{L_y}{y}$  then the total wage cost per unit output will be  $a_y \bar{w}_T$ . Second, the start-up entrepreneur recruits from the traditional sector and relates his entrepreneurial income to the subsistence income of employed or self-employed  $\bar{w}_T$  in the traditional sector by adding a profit margin  $\bar{\pi}_y$ . Hence, his expected income is  $(1 - \vartheta_y)(\bar{w}_T + \bar{\pi}_y)$ . Where  $(1 - \vartheta_y)$  is the probability of business failure. This income is the minimum income the entrepreneur would like to earn from his business. Thus total operating costs will be

$$c_y = \bar{c}_y + a_y \bar{w}_T + \bar{w}_T + \bar{\pi}_y = \bar{c}_y + (a_y + 1) \bar{w}_T + \bar{\pi}_y \quad (5)$$

Due to these start-up costs, once a firm is started up it will remain monopolistic for the specific service/product variation. As a result, each period's profits are determined by the price of the product variation  $p$  and the operating costs  $c_y$ , i.e.  $\pi_y = (p - c_y)y$ . The expected net present value of such a monopoly is

$$EV_y^m(\tau) = (1 - \vartheta_y) \int_{\tau}^{\infty} (p - c_y) y e^{-r^d(t,\tau)(t-\tau)} dt$$

where  $\vartheta_y$  represents the expected rate of business failure and  $(1 - \vartheta_y)$  the expected rate of success. Monopoly profits are maximized by the optimal choice of the intermediate good price  $p$  as

$$p = \frac{c_y}{\alpha}, \quad (6)$$

where  $\alpha$  is the elasticity of production of intermediates in the final goods sector. With the optimal price rule we can also determine periodic profits. Each period's profits is determined by the price of the optimal product variation (6) and the periodic costs (5). Net periodic profits are given by  $\pi_y = (p - c_y) y$  and hence

$$\pi_y = (1 - \alpha) \alpha^{\frac{1+\alpha}{1-\alpha}} c_y^{\frac{-\alpha}{1-\alpha}}$$

As a result, the expected maximum net present value of a new firm is

$$EV_y^m = \frac{(1 - \vartheta_y)}{r^d} (1 - \alpha) \left( \frac{\alpha^{1+\alpha}}{c_y^\alpha} \right)^{\frac{1}{1-\alpha}} \quad (7)$$

**Financing the new firm.** Since the prospective entrepreneur is assumed to have no immediate income or accumulated savings, the start-up costs  $\chi_y$  must be externally financed. The loan rate is denoted by  $r^l$ . To simplify, we assume a firm that revolves loans infinitely and services interest only (Ponzi finance is excluded). Denoting the deposit rate  $r^d$ , the present value of start-up costs ( $V_y^s$ ) including finance is

$$V_y^s = \chi_y \frac{r^l}{r^d}$$

As long as there is no stationary state, start-up entrepreneurs realize a net rent. However, in a steady state equilibrium the net present value of the new firm will just cover total start-up costs which,  $V_y^s = V_y^m$ . Thus periodic monopoly rents are eventually fully distributed as income of the entrepreneur and under competition used to finance start-up costs. We can extend this to take into account non-pecuniary benefits of entrepreneurship (since entrepreneurial rents are often found to be less than returns from wage employment, see e.g. Hamilton, 2000) but for the sake of simplicity we leave this for future elaboration. With respect to financial markets, start-up activities by entrepreneurs lead to a perfectly elastic loan demand

$$r^l = \frac{(1 - \vartheta_y)(1 - \alpha) \alpha^{\frac{1+\alpha}{1-\alpha}} c_y^{\frac{-\alpha}{1-\alpha}}}{\chi_y} \quad (8)$$

### 3.2.4 Financial Intermediation

Given that the financial sector is often not very well developed in a developing economy, especially an economy where there is a large traditional sector, we allow for imperfections in financial markets to affect credit availability to prospective start-ups. Following Stiglitz and Weiss (1981) it is widely accepted that informational asymmetries and agency problems can result in newer, smaller firms finding it difficult to access sufficient external finance, i.e. being credit rationed (Bonnet et al., 2005). The problem of small firms being credit rationed can be more severe if the modern sector is characterized by a high concentration of market power by financial intermediaries/banks. In order to model concentration of market power in the financial market we look at a number of banks  $B$ . Each individual bank  $b$  offers deposits  $D_b$  to households and loans  $K_b$  to potential start-up firms. With loan volume of  $K_b$  and start up costs of  $\chi_y$  total volume of loans so far has financed the sum of all start-up costs over time  $\sum^{N_y} \chi_y$  and hence from a current perspective for the historically given average start-up costs  $\bar{\chi}_y$  we obtain the current number  $N_y = BK_b/\bar{\chi}_y$  of existing entrepreneurial start-ups that could have been financed in this economy so far. Banks have symmetric monitoring costs  $c_B$  for each deposit and fixed costs as fraction of GDP of  $\bar{c}_b$  for the internal institutional monitoring infrastructure of the bank. In the simplest case we consider here domestic banks issue deposits for domestic customers. The expected profit function of bank  $b$  is given as:

$$E\pi_b = r^l (1 - \vartheta_y) K_b - r^d(D) D_b - c_b (\vartheta_y) K_b - \bar{c}_b, \quad (9)$$

where  $r^d(D)$  is the deposit demand function and  $D$  denotes total deposits in the region, and  $\vartheta$  is the expected default rate of the loans given to entrepreneurs. The equilibrium deposit interest rate depends upon total deposits,  $D \equiv \sum_{b=1}^B D_b = BD_b$ . With the bank modelled as a pure intermediary, its balance sheet can be written as

$$K_b = D_b. \quad (10)$$

This takes into account the number of competing banks as well as the semi-elasticity of deposit demand  $\frac{\partial D}{\partial r^d} \frac{1}{D} = \eta_D$  which in case of a closed financial system is  $1/\Theta$ . As we assume that foreign investors do not blindly make investments (or extend loans) in the financial system of the developing country we do not need to unpack such financial flows. Therefore we obtain an domestically determined optimal deposit-loan rate spread for banks as the solution to the banks' optimization problem

$$r^d = r^l (1 - \vartheta_y) - c_b - \frac{1}{\eta_D \bar{B}} \quad (11)$$

As can be seen from equation (11) an economy's spread is determined by two factors, namely the costs of monitoring ( $c_b$ ) and the elasticity of deposit demand as well as the level of bank concentration  $\frac{\partial r^d}{\partial D} \frac{D}{\bar{B}} = \frac{1}{\eta_D \bar{B}}$ . An increasing premium on foreign funding lowers the elasticity of deposit demand and widens

the interest spread. In principle the level of  $\eta_D$  can have a range between highly integrated markets with a highly elastic deposit demand up to a closed economy where deposit demand is restricted by the domestic preferences  $\eta_D = 1/\Theta$ . For present purposes we take  $\eta_D$  as pure domestic parameter.

As long as there are net profits in the market we may see market entry. Hence, the zero profit condition [ $E\pi_b = 0$ ] defines the long-term equilibrium and determines the equilibrium number of banks  $\tilde{B}$ .

$$\tilde{B} = \frac{D_{b0}}{\bar{c}_{b0}\eta_D} \quad (12)$$

### 3.2.5 Stationary Equilibrium in the Modern Domestic Sector

Combining the elements in the previous sub-sectors, results in Proposition 1.

**Proposition 1** *The growth rate of the number of start-ups (and hence the stationary growth rate of the modern sector)  $\frac{\dot{N}_y}{N_y}$ , depends on two sets of parameters. a) Characteristics of the real economy, specifically the start up costs  $\chi_y$ , costs of running the business  $c_y$ , and the probability of failure  $\vartheta_y$ . b) The efficiency of the financial intermediation sector, described by marginal monitoring costs  $c_b$ , and costs of monitoring infrastructure  $\bar{c}_b$ .*

$$\frac{\dot{N}_y}{N_y} = \frac{1}{\Theta} \left[ \frac{(1 - \vartheta_y)^2 (1 - \alpha)}{\chi_y} \alpha^{\frac{1+\alpha}{1-\alpha}} c_y^{\frac{-\alpha}{1-\alpha}} - c_b - \frac{\bar{c}_{b0}}{D_{b0}} - \rho \right] \quad (13)$$

Proof: See Appendix 1.

## 3.3 Modern International Sector

In order to include effects from international integration, both from exports and international financial transactions we define a modern international sector. As mentioned in section 2.1 we keep the model analytics tractable by assuming that exports consists of the production of intermediate goods as part of a global value chain, exclusively for the international market, and that start-ups in this export sector (international entrepreneurship, see section 2.2) is financed exclusively from foreign sources either as specific financial investment in a firm (FDI), or even through international aid inflows.

### 3.3.1 Foreign Traded Intermediate Goods:

The *traded intermediate goods* are described by the demand  $x_j$  for each of the  $j = 1 \dots N_x$  specific intermediates produced for further processing in an internationalized production chain. As international demand for each variation depends on the price in international goods  $\theta_j$  the total demand for each representative variation is supposed to be iso-elastic with

$$x = (\theta)^{-\eta_x} \quad (14)$$



### 3.3.2 International Entrepreneurship

INVs come into being when entrepreneurs meet the need for an unique intermediate input into a global value chain and obtain start-up finance from an international investor (or donor). In most respects the treatment of the start-up decision is similar to that of the domestic sector.

**Start-Up of INVs.** The start-up of this new variation again includes costs of the initial capital outlay, denoted by  $\chi_x$ .

**Operating the INV.** In addition to start-up costs there are recurring costs to operate the business, denoted by  $c_x$  and consisting of costs related to the specific start-up firm  $\bar{c}_x$ , total wage cost  $c_x = a_x \bar{w}_T$  and entrepreneurial income  $\bar{\pi}_x$ .

$$c_x = \bar{c}_x + (a_x + 1) \bar{w}_T + \bar{\pi}_x \quad (15)$$

Once an INV is started, it will remain monopolistic for the specific service/product innovation so that each period's profits are determined by the price of the product variation  $\theta$  and the operating costs  $c_x$ , i.e.  $\pi_x = (\theta - c_x)x$ . The expected net present value of such a monopoly is

$$EV_x^m(\tau) = (1 - \vartheta_x) \int_{\tau}^{\infty} (\theta - c_x) x e^{-r^w(t,\tau)(t-\tau)} dt$$

where  $\vartheta_x$  represents the probability of firm failure in the international sector, and  $(1 - \vartheta_x)$  is the probability of firm survival. Monopoly profits are maximized by the optimal choice of the intermediate good price  $\theta$  as

$$\theta = \frac{c_x}{1 - \frac{1}{\eta_x}} \quad \infty > \eta_x > 1 \quad (16)$$

where  $\eta_x$  is the elasticity of demand for this product variation. In developing economies we can expect that due to high standardization and competition  $\eta_x$  is rather high, even when we assume that due to transaction and information costs it is less than infinity. With the optimal price rule we can also determine periodic profits. Each period's profits is determined by the price of the product variation (16) and the periodic costs (15). Net periodic profits are given by  $(\theta - c_x)x$  and hence

$$\pi_x = \frac{1}{\eta_x} \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right)^{1-\eta_x}$$

As a result, the expected maximum net present value of an INV is

$$EV_x^m = \frac{1 - \vartheta_x}{r^w} \frac{1}{\eta_x} \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right)^{1-\eta_x}$$

**Financing the INV.** Since the prospective entrepreneur is assumed to have no immediate income or accumulated savings, the start-up costs  $\chi_x$  must be externally financed. The loan rate is denoted by  $r^f$ . To simplify, we assume a firm that revolves loans infinitely and services interest only (i.e. Ponzi finance is excluded). Denoting the world risk free interest rate  $r^w$ , the present value of start-up costs ( $V_x^s$ ) including finance is

$$V_x^s = \chi_x \frac{r^f}{r^w}$$

As long as there is no steady state equilibrium, start-up entrepreneurs realize a net rent. However, in steady state equilibrium the net present value of the new firm will just cover total start-up costs, i.e.  $V_x^s = V_x^m$ . Thus periodic monopoly rents are eventually fully distributed as income of the entrepreneur and under competition used to finance start-up costs. With respect to financial markets, start-up activities by entrepreneurs lead to a perfectly elastic demand for finance

$$r^f = \frac{1 - \vartheta_x}{\chi_x} \frac{1}{\eta_x} \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right)^{1 - \eta_x} \quad (17)$$

### 3.3.3 Foreign (Direct) Investments in the International Sector

To simplify, the international sector obtains its finance only from international investors. These international financial resources  $F$  are either financial investments directly channeled into the export sector of the developing economy or FDI. In both cases this finance is part of the international portfolio choice of the lender. For a given amount of world wealth  $W$  a fraction  $f$  will be allocated into this developing economy as foreign finance. The portfolio choice depends on the returns to foreign loans or investment  $r^f$  relative to the given return of the world's risk free international assets,  $r^w$

$$F = f(r^w, r^f)W, \quad \frac{\partial f}{\partial r^f} > 0, \quad \frac{\partial f}{\partial r^w} < 0$$

We can now determine how many INVs can be financed at any given moment. Since the start-up of INVs depend on finding an international investor, we can see the creation of INVs as the establishment of domestic firms that are being financed by international investments. Under competition the firm can pay a return of  $r^f$  to any investor who either buys the business idea and pays for the start-up costs as foreign owner, or just finances the start up costs as external creditor. With the cost per start up INV  $\chi_x$  we can derive the optimal number of INVs financed by the investment value determined by the portfolio decision of international investors

$$N_x = \frac{F}{\chi_x}$$

We can also determine the number of INVs per unit of wealth  $\lambda$  as

$$\lambda = \frac{N_x}{W}$$

### 3.3.4 Stationary Equilibrium in the International Sector

For a portfolio choice the optimal proportion of developing country INVs funded,  $F^*$  depends on the relative asset returns of the real investment in the exporting firm  $r^f$  and the world risk free interest rate  $r^w$ . Increasing return on investment in INVs in the developing economy results in a growing number of INVs. For a stationary structure of investments/loans the path of foreign funding depends on general wealth accumulation in the world  $\dot{W}$ . This leads to Proposition 2.

**Proposition 2** *At any time the optimal number of INVs in the international sector  $N_x^*$  is a function of the world's risk free interest rate  $r^w$ , and the determinants of the return on investment of the INV, specifically  $\eta_x$  and  $\chi_x, \bar{c}_x, \vartheta_x$ . Accordingly the steady state growth rate of the international sector  $\frac{\dot{N}_x^*}{N_x^*}$  is a function of the growth rate in the world's wealth  $\frac{\dot{W}}{W}$ . Formally*

$$\begin{aligned} N_x^*(t) &= \lambda^*(r^w, \chi_x, \bar{c}_x, \vartheta_x, \eta_x) W(t) \\ \frac{\dot{N}_x^*}{N_x^*} &= \frac{\dot{F}}{F} = \frac{\dot{W}}{W} \end{aligned}$$

Proof: See Appendix 2.

## 3.4 The Traditional Sector

### 3.4.1 Lewis' Surplus Labour and Poverty

The traditional sector is the surplus labour economy. In this sector people consume what they produce at the subsistence level  $\bar{w}_T$ . The traditional sector is assumed to employ a maximum of  $\bar{L}_T$  labour at the potential productivity level  $1/a_T$ , hence labour surplus, defined by the rate  $\delta_T = \frac{U}{L_T}$ , is not contributing productively. As a result, average income in the traditional sector is less than  $\bar{w}_T$ , and surplus labour in the traditional sector is just waiting to get the opportunity to switch to any employment. However, this opportunity must be provided somehow. In this model it is the start-up of a new firm, where either the entrepreneur will utilize an opportunity for himself or even create job opportunities for others. These income generating occupations are the result of a growing number of new start-ups  $N_y$  producing for the modern domestic or international sector  $N_x$  and absorbing surplus labour  $L_y, L_x$ . Accordingly,

$$L_y = N_y (a_y + 1), \quad L_x = N_x (a_x + 1). \quad (18)$$

This indicates that our model corresponds to the basic idea of the Lewis (1954) model. In the traditional sector  $\bar{w}_T$  is the long term subsistence wage, and can be regarded as a poverty line. The poverty gap  $\varepsilon_T$  in the traditional

sector considers household income after it has been shared with family members in the labour surplus pool. It is the percentage income realized for each family member compared to the poverty line earned by  $\bar{L}_T$  employed in the traditional sector.

$$\varepsilon_T = \bar{w}_T - \frac{\bar{w}_T \bar{L}_T}{\bar{L}_T + U}$$

The poverty gap in the traditional sector will decline as new jobs are created by entrepreneurial start-ups in the modern sector, leading to a reduction of surplus labour and an increase in average shared income in the traditional sector. Both the domestic and international sectors absorb surplus labour. This first effect helps people to leave poor conditions. Due to comparative advantages, INVs may be particularly labour-intensive, hence encouraging INVs may be even be more effective for absorbing surplus labour than the domestic final product sector, consistent with the idea of export-led poverty reduction.

### 3.4.2 Current Conditions in the Traditional Sector

For the traditional sector we may determine the rate of absorption of surplus labour and the changes that might occur during a global economic crisis. We denote total labour by  $\bar{L}$ , the maximum labour employable in the traditional sector by  $\bar{L}_T$ , and the amount of surplus labour by  $U$ . Now we can forward proposition 3.

**Proposition 3** *The speed of the reduction of the surplus labor rate  $\dot{\delta}_T$  is a function of the speed of absorption of labour by new start-ups in the modern domestic and international sectors, and the speed of reduction of surplus labour determines the speed of reducing the poverty gap,  $\dot{\varepsilon}_T$ .*

$$\begin{aligned} \delta_T(t) &= \frac{\bar{L}}{\bar{L}_T} - \frac{N_y(t)}{\bar{L}_T} (a_y + 1) - \frac{N_x(t)}{\bar{L}_T} (a_x + 1) - 1 \\ \dot{\delta}_T &= -\frac{(a_y + 1) N_y(t) \dot{N}_y}{\bar{L}_T N_y} - \frac{(a_x + 1) N_x(t) \dot{N}_x}{\bar{L}_T N_x} \\ \varepsilon_T(t) &= \frac{\delta_T(t)}{1 + \delta_T(t)}, \quad \dot{\varepsilon}_T = [1 - \varepsilon_T(t)] \frac{\dot{\delta}_T}{\delta_T} \end{aligned}$$

Proof: See Appendix 3.

To understand proposition 3 intuitively it is useful to start off from the fact that new start-up firms are the link between the modern sectors (domestic or international) and the traditional sector. If infrastructure and market conditions in the former are favourable creative and innovative entrepreneurs can draw on the surplus labour from the traditional sector and provide a competitive and innovative new input. While in the classic Lewis economy abstract capital accumulation automatically generates jobs to absorb surplus labour, here we include an explicit consideration of decentralized small firms.

## 4 Financial Crisis, Contagion and Structural Stagnation

There have been many financial crises without accompanying trade contractions or global systemic effects. In such a case Gries and Naudé's (2010) closed-economy Lewis-type model of structural change and entrepreneurship provide a useful tool to illustrate and model the impacts of a financial crisis on structural change in a developing country. For purposes of exposition, we therefore start the analysis of the global economic crisis by using a graphical analysis to trace out the economic structural dynamics of a financial contraction as well as its contagion effects-particularly in an economy not financially integrated into the world economy. Then, in section 5 we analyse financial and trade shocks in the open economy version of the model set out in section 3 of this paper.

A core result of the Gries-Naudé model is contained in Figure 1, which is also used to explore the impact of a financial crisis, both when it originates domestically, or from another country. From the Gries-Naudé model and the presentation of the domestic modern sector in section 3.2, we can state Proposition 4.

**Proposition 4** *If a financial crisis results in (i) increased start-up costs  $\chi_y$ , costs of running a firm  $c_y$ , and the probability of firm failure  $\vartheta_y$ , and/or (ii) in increased intermediation costs, specifically marginal monitoring costs  $c_b$ , or the costs of banks' monitoring infrastructure  $\bar{c}_b$ , then the number of new firm start-ups in the economy  $\frac{\dot{N}_y}{N_y}$ , will decrease*

$$\begin{aligned} \text{a)} \quad & \frac{d\frac{\dot{N}_y}{N_y}}{d\chi_y} < 0, & \frac{d\frac{\dot{N}_y}{N_y}}{dc_y} < 0, & \frac{d\frac{\dot{N}_y}{N_y}}{d\vartheta_y} < 0, \\ \text{b)} \quad & \frac{d\frac{\dot{N}_y}{N_y}}{dc_b} < 0, & \frac{d\frac{\dot{N}_y}{N_y}}{d\bar{c}_b} < 0, & \frac{d\frac{\dot{N}_y}{N_y}}{dB} < 0 \end{aligned}$$

With a slower new firm start-up growth  $\frac{\dot{N}_y}{N_y}$  the reduction in the labour surplus  $\dot{\delta}_T$  and poverty  $\dot{\varepsilon}_T$ , will slow down, i.e.

$$\frac{d\dot{\delta}_T}{d\frac{\dot{N}_y}{N_y}} < 0, \quad d\frac{\dot{\varepsilon}_T}{\varepsilon_T} = \frac{[1 - \varepsilon_T(t)]}{\delta_T(t)} d\dot{\delta}_T > 0$$

Proof: See Appendix 4.

To illustrate proposition 4 we consider increases in monitoring costs and hence higher levels of bank concentration with the help of Figure 1. In panel (a) of Figure 1 the banking sector's efficiency is compared with the benchmark case of a perfect market, represented by the 45-degree line. This loan supply curve is upward sloping as a higher loan rate allows banks to pay a higher deposit rate and maintain (zero) profits. In the same panel the loan demand is

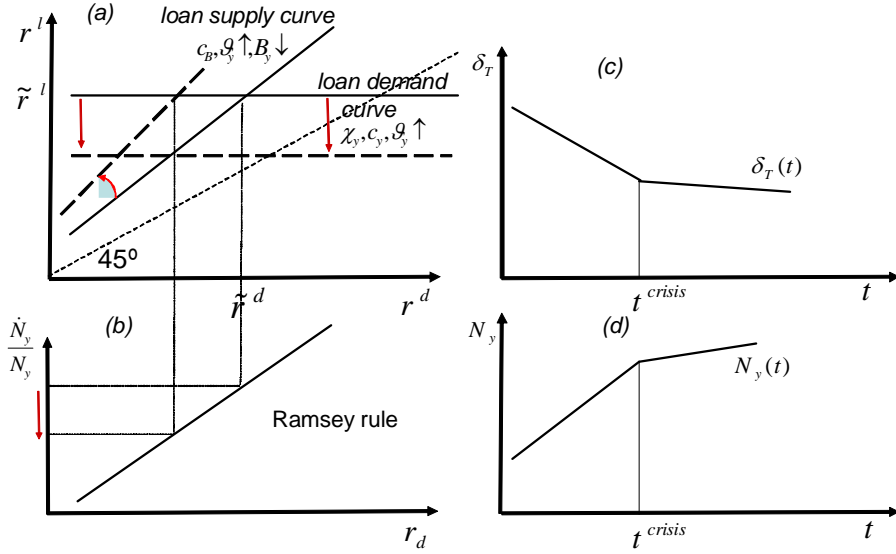


Figure 1: Increasing monitoring costs, and bank concentration

depicted as a horizontal line. This is because, as is reflected in (8) loan demand from start-ups is fully elastic at the determined level  $r^l$ . If financial markets are perfect, then the loan rate entrepreneurs are able to pay would translate into an identical deposit rate for financial investors. In case of imperfect intermediation the deviation from the 45-degree line would depend on the extent of market frictions. Proposition 4 puts forward that both marginal costs and bank infrastructure costs, increase after a financial crisis, and both will drive a gap between the loan supply curve and the perfect market conditions. This imperfection is represented by the optimal interest spread (11). The gap can also be due to increasing concentration in the financial sector as a result of the reduction in leeway possible for banks. The rise in business failures  $\vartheta_y$  during a crisis provides a further motivation for more conservative lending by banks. These effects directly or indirectly impact on the parameters  $c_b$  and  $\bar{c}_b$ . As a result, in panel (a) of Figure 1, the loan supply curve shifts upwards to the left. The result is an increasing spread and increasing bank concentration. In turn, as panel (b) in figure indicates, the increase in the loan deposit interest spread, in accordance with the Ramsey rule, the optimal growth rate is depressed downwards. Decreased access to finance as a result of increased bank concentration and an increasing interest spread will further lower the start-up rate. At the end of the resulting chain reaction the entrepreneurial start-up rate is lower, with negative repercussions for structural change and poverty alleviation. The resulting time paths for start-ups (innovation) and poverty alleviation are de-

picted in panels (d) and (c) of figure 1. In panel (d) of 1 we plot the time path of new start-ups. At the occurrence of the crisis the growth rate of start-ups will show a structural break with a subsequent reduced slope (reduced rate of growth). In panel (c) of Figure 1 the effect on poverty (through surplus labour) is plotted over time, showing a decline in the rate of poverty alleviation to the extent that new firm growth (and innovation) slow down.

## 5 A Global Economic Crisis and Structural Stagnation

In the previous section we illustrated a financial crisis, in a domestic sector of the economy. In this section we use the open economy model developed in section 3 to analyse the impact of both a financial as well as a trade crisis, as in the global economic crisis of 2008-2009. First we consider a financial contraction.

### 5.1 An International Financial Crunch

In our open economy setting two features of the financial crunch in particular will impact on entrepreneurship, as discussed in section 2.2. We set these out in Proposition 5.

**Proposition 5** *Following a contraction in world wealth  $dW < 0$ , and/or an increase in the long term risk free world interest rate  $r^w > 0$  the optimal number of INVs in developing economies,  $dN_x^*$  will decrease, i.e.*

$$\frac{dN_x^*}{dr^w} < 0, \quad \frac{dN_x^*}{dW} > 0$$

Proof: See Appendix 5.

Proposition 5 can be illustrated with the help of Figure 2. Thus, first, the crisis will lead to an upward adjustment of the expected level of the world's long-term risk free interest rate  $r^w$  as credit is crowded out by uncertainty, bailouts and the accumulation of government debt. Second, the massive drop in asset prices following the outbreak of the crisis will contribute to a significant reduction in aggregate world wealth. In Figure 2 both effects can be identified. In panel (a) an increase in the world's long-term risk free interest rate  $r^w$  leads international funders to adjust their portfolios, leading to a smaller fraction of wealth allocated for international investment/loans for each given  $r^f$ . The result is that the number of INVs that will be supported declines per unit wealth as a result of an adjusted portfolio structure. In panel (a) of Figure 2 this leads to a decrease in  $\lambda^* = \frac{N_x^*}{W}$ . Furthermore a reduction in world wealth further reduces the funding of INVs indicated in panel (b) of Figure 2 through a shift in the  $\lambda^*W$  curve. These two effects reduce the optimal (desired) number of INVs  $N_{x1}^*$  in the finance portfolios of international lenders. Right after the crisis

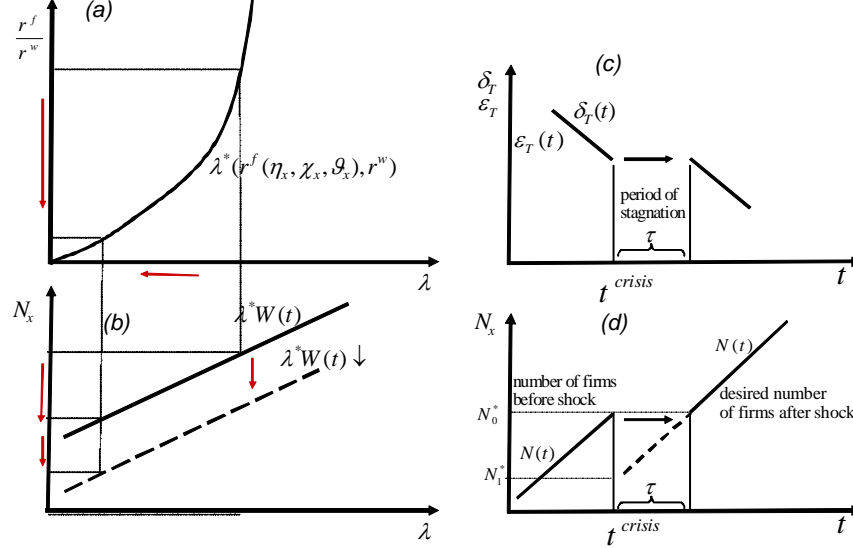


Figure 2: Effects of export, world return and wealth shocks on SMEs

the optimal number of INVs will be smaller than the existing number  $N_{x0}$ . A portfolio adjustment of the existing firms towards the optimal number of firms begins. This is shown in panel (d) of Figure 2. Closing down existing INVs that have negative cash flows could result in windfall losses. However, as there may be a number of firms with positive cash flows remaining in the market can minimize losses. Consequently international lenders would not finance INVs in developing countries until the desired number coincides with the existing number. Hence proposition 6 can be states.

**Proposition 6** *A contraction in foreign funding of INVs will lead to a downward adjustment in the number of INVs ( $N_x^*$ ) over an adjustment period  $\tau$  and hence to stagnating entrepreneurial and innovation growth ( $\dot{N}_x = 0$ ). As a consequence we obtain a stagnating surplus labour ( $\dot{\delta}_T = 0$ ), and stagnating poverty ( $\dot{\epsilon} = 0$ ).*

$$\left. \begin{array}{l} \dot{N}_x = 0 \\ \dot{\delta}_T = 0 \\ \dot{\epsilon} = 0 \end{array} \right\} \text{ for period } \tau = \frac{\ln(N_x(0) - N_x^*(0)) - \ln N_x^*(0)}{\frac{\dot{W}}{W}}$$

Proof: See Appendix 6.



As shown in panel (d) of Figure 2, after the shock of the crisis the optimal number of firms in the portfolio of international lenders is lower than the actual number [ $N_x > N_x^*$ , see figure 2 panel (d)]. Hence, international investors would not fund additional INVs as long as the world wealth accumulation reaches a level such that again the desired number of firms coincides with the actual existing number of firms. Thus the negative impact of an increasing world interest rates can eventually be compensated if world wealth levels recover over the period  $\tau$ . This could be a gradual or quicker process depending on the extent and speed of global recovery. The longer it takes, the longer structural adjustment and poverty alleviation will be delayed.

Figure 2 panel (c) describes the time path of the surplus labor rate and the poverty gap. Both stagnates for period  $\tau$ . Therefore poverty reduction as well as the process of structural transformation will continue to be affected well after the immediate urgency of the crisis is over.

## 5.2 Foreign Trade Shock

The financial crisis of 2008-2009 had an large impact on global trade. Since many successful developing countries followed and export-driven growth strategy the effects of a sudden decline in global trade should also be analysed. Such a decline reduces the demand for intermediates in the international production chain, and increases competition between contributors in this chain. In our model this is reflected in an increase in the elasticity of demand for each intermediate product. As a result the profitability of INVs declines and the rate of return from international finance,  $r^f$ , falls. International investors then adjust their portfolios to include fewer INVs in their portfolio  $\lambda^* = \frac{N_x^*}{W}$ . This leads us to proposition 7.

**Proposition 7** *A contraction in world export demand will lead to an increase in the demand elasticity of exports from the developing economy  $\eta_x$  (increasing values of  $\chi_x, \bar{c}_x$ , and  $\vartheta_x$ ) and a decrease in the profitability of INV,  $r^f$ . Hence the desired number of INV ( $N_x^*$ ) to be funded by international investors for each unit of wealth  $\lambda^*$  would decline. For this shock proposition 6 also holds*

$$\frac{dN_x^*(t)}{d\eta_x} < 0, \quad \frac{dN_x^*(t)}{d\vartheta_x} < 0, \quad \frac{dN_x^*(t)}{d\bar{c}_x} < 0$$

Proof: See Appendix 7.

The negative impact of a sudden drop in global trade hits export oriented entrepreneurs in the international sector of the developing country. Higher competition leads to a reduction in the internal rate of return  $r^f$ . Figure 2 illustrates the resulting mechanisms which are broadly similar to the effects discussed for the the change in the world's risk free interest rates. The change in relative returns affects the portfolio decision [see panel (a) in Figure 2], and  $\lambda^*$  shows the effect of portfolio adjustments on the optimal number of firms that investors are willing to finance for a given level of wealth. The optimal number

of firms in the portfolio declines and stagnation occurs until the number of existing firms coincides with the optimal number of firms [see again panel (d) of Figure 2]. The effects on poverty reduction is similar to the description in the previous subsection.

## 6 Concluding Remarks

Our paper has highlighted a number of still neglected aspects of the global economic crisis. First, we have provided an initial formalization of the analytics of such crises in the framework of an endogenous growth model. Second we had emphasized the differences between short-term and long-term impacts. Third, in terms of the latter we have shown that entrepreneurial behaviour-through start-ups of new firms and innovation-is an important channel through which crises affects longer-term structural change. This impact of crises are still underappreciated. Only recently for instance did the OECD (2009: 5) warn that the impact of the global economic contraction through start-up and innovative activity could be detrimental to structural change, stating that restrictions on the entry of innovative start-ups and a slowing down of global knowledge transfers, diffusion and adoption as a result of shrinking trade and finance could negative affect 'the ability of the economy to reallocate resources from declining industries to newly emerging industries and new opportunities'. The model analytics identified a number of challenges for structural change and catch-up in a post-crisis world, such as dealing with greater bank concentration, higher costs of bank monitoring and stricter regulations and collateral requirements, a flight-to-safety effect in global finance, reduced incentives for innovation and job-creating start-ups.

## References

- [1] Acs, Z.J., Desai, S. and Hessels, J. (2008). 'Entrepreneurship, Economic Development and Institutions', *Small Business Economics*, 31: 219-234.
- [2] Acz, Z. and Szerb, L. (2009). 'The Global Entrepreneurship Index', *Foundations and Trends in Entrepreneurship*, 5 (5): 341-435.
- [3] Amorós, E., Cristi, O. and Naudé, W.A. (2010). 'Romanticizing Penniless Entrepreneurs? Poverty, Vulnerability, Non-Monetary Welfare and Business Start-Up Rates Across Countries', *Paper prepared for the Babson College Entrepreneurship Research Conference*, Lausanne, Switzerland, 9 - 12 June 2010.
- [4] Audretsch, D. and Sanders, M. (2010). 'Technological Innovation, Entrepreneurship and Development', (In Szirmai, A., Naudé, W.A. and Goedhuys, M. eds. *Innovation and Entrepreneurship in Developing Countries*. Oxford: Oxford University Press - forthcoming).

- [5] Banerjee, A. and Newman, A. (1993). ‘Occupational Choice and the Process of Development’, *Journal of Political Economy*, 101(2): 274-98.
- [6] Barth, J. R. (2008). ‘US Subprime Mortgage Meltdown’. *Paper presented at the 14th Dubrovnik Economic Conference*, 25 June. Dubrovnik Available at [www.hnb.hr/dub-konf/14-konferencija/barth.ppt](http://www.hnb.hr/dub-konf/14-konferencija/barth.ppt).
- [7] Bonnet, J., Cieply, S. and Dejardin, M. (2005). ‘Financial constraints on new firms: Looking for regional disparities’, *Discussion paper no 3705*, Max Planck Institute of Economics, Jena.
- [8] Cagetti, M. and De Nardi, M. (2005a). ‘Wealth Inequality: Data and Models’, Federal Reserve Bank of Chicago, *Working Paper WP 2005-10*. Chicago.
- [9] Cagetti, M. And De Nardi, M. (2005b). ‘Entrepreneurship, Frictions, and Wealth’, *Journal of Political Economy*, 114(5): 835-70.
- [10] Chenery, H.B. (1960). ‘Patterns of Industrial Growth’, *American Economic Review*, 50: 624-654.
- [11] Cho, D. (2009). ‘Banks Too Big to Fail Have Grown Even Bigger’, *The Washington Post*, 28 Aug.
- [12] EC (European Communities) (2009). *Overcoming Fragility in Africa : The European Report on Development*. Brussels, Belgium.
- [13] Ely, B. (2009). ‘Bad Rules Produce Bad Outcomes: Underlying Public-Policy Causes of the U.S. Financial Crisis’, *Cato Journal*, 29 (1): 93-114.
- [14] Ethier, W.J. (1982). ‘National and International Returns to Scale in the Modern Theory of International Trade’, *American Economic Review*, 72 (3): 389-405.
- [15] Evans, D.S. and Jovanovic, B. (1989). ‘An Estimated Model of Entrepreneurial Choice under Liquidity Constraints’, *Journal of Political Economy*, 97(4): 808-27.
- [16] Felton, A., and K. Reinhart (2008). ‘The First Global Financial Crisis of the 21st Century’. A VoxEU.org Publication. Available at [www.voxeu.org/index.php?q=node/1352](http://www.voxeu.org/index.php?q=node/1352).
- [17] Freedman, C., Kumhof, M., Laxton, D. and Lee, J. (2009). ‘The Case for Global Fiscal Stimulus’, *IMF Staff Position Note, SP/09/03*, 6 March.
- [18] Friedman, J. and Schady, N. (2009). ‘How Many More Infants Are Likely to Die in Africa as a Result of the Global Financial Crisis?’, *Policy Research Working Paper # 5023*, The World Bank, Washington DC.

- [19] Gries, T. and Naudé, W.A. (2009). ‘Entrepreneurship and Regional Economic Growth: Towards a General Theory of Start-Ups’, *Innovation: The European Journal of Social Science Research*, 22 (3): 309-328. Sept.
- [20] Gries T., and Naudé, W.A. (2010). ‘Entrepreneurship and Structural Economic Transformation’, *Small Business Economics Journal*, 34 (1): 13-29.
- [21] Gorodnichenko, Y. and Schnitzer, M. (2010). ‘Financial Constraints and Innovation: Why Poor Countries Don’t Catch Up’, *Discussion Paper no. 4786*, Institute for the Study of Labor (IZA), Bonn.
- [22] Hamilton, B.A. (2000). ‘Does Entrepreneurship Pay? An Empirical Analysis of the Returns to Self-Employment’, *Journal of Political Economy*, 108(3): 604-31.
- [23] Johnson, S. (2009). ‘The Quiet Coup’, *The Atlantic*, May 2009.
- [24] Kedrosky, P.S. (2008). ‘Entrepreneurs and Recessions: Do Downturns Matter?’, Ewing Marion Kauffman Foundation. Working Paper.
- [25] Kirzner, I.M. (1973). *Competition and Entrepreneurship*. Chicago: University of Chicago Press.
- [26] Kuznets, S. (1966). *Modern Economic Growth: Rate, Structure and Spread*. New Haven: Yale University Press
- [27] Koellinger, P. and Thurik, R. (2009). ‘Entrepreneurship and the Business Cycle’, *Tinbergen Institute Discussion Paper no. 09-032/3*. The Tinbergen Institute.
- [28] Laeven, L., and F. Valencia (2008). ‘Systemic Banking Crises: A New Database’. *IMF Working Paper WP/08/224*. Washington, DC: IMF.
- [29] Lewis, W.A. (1954). ‘Economic Development with Unlimited Supplies of Labour’, *The Manchester School*, 28(2): 139-191.
- [30] Lin, J. Y. (2008). ‘The Impact of the Financial Crisis on Developing Countries’. Paper presented at the Korea Development Institute, 31 October. Seoul.
- [31] Loser, C.M. (2009). ‘*Global Financial Turmoil and Emerging Market Economies: Major Contagion and a Shocking Loss of Wealth?*’, Asian Development Bank.
- [32] McDougall, P., and B. M. Oviatt (2003). ‘Some Fundamental Issues in International Entrepreneurship’. Mimeo Available at [www.usasbe.org/knowledge/whitepapers/mcdougall2003.pdf](http://www.usasbe.org/knowledge/whitepapers/mcdougall2003.pdf).
- [33] Mesnard, A. and Ravallion, M. (2005). ‘The Wealth Effect on New Business Startups in a Developing Country’. IFPRI/Cornell Conference on Threshold Effects and Non-Linearities in Growth and Development, Washington DC, 11-13 May.

- [34] Minniti, M. and Naudé, W.A. (2010). 'What do We Know About the Patterns and Determinants of Female Entrepreneurship Across Countries?', *The European Journal of Development Research*, 22 (2). 1-17.
- [35] Naudé, W.A.(2007). Peace, Prosperity and Pro-Growth Entrepreneurship, *UNU-WIDER Discussion Paper WDP 2007/02*, United Nations University, Helsinki, Finland.
- [36] Naudé, W.A. (2008). 'Entrepreneurship in Economic Development', *UNU-WIDER Research Paper No. 2008/20*, United Nations University, Helsinki, Finland.
- [37] Naudé, W.A. (2009a). 'Entrepreneurship, Post-Conflict' (In Addison, T. and Brück, T. eds. *Making Peace Work: The Challenges of Social and Economic Reconstruction*. Basingstoke: Palgrave Macmillan. Chapter 11, pp.251-263.)
- [38] Naudé, W.A. (2009b). 'Fallacies About the Global Financial Crisis Harms Recovery in the Poorest Countries', *CESifo Forum*, Dec, 4 : 3 – 12.
- [39] Naudé, W.A. (2010a). 'Entrepreneurship, Developing Countries and Development Economics: New Approaches and Insights', *Small Business Economics Journal*, 34 (1): 1-12.
- [40] Naudé, W.A. (2010b). *Entrepreneurship and Economic Development*. Basingstoke: Palgrave Macmillan. Forthcoming.
- [41] Naudé, W.A. (2010c). 'Africa And The Global Economic Crisis: A Risk Assessment And Action Guide. *Robert Schuman Centre for Advanced Studies Working Paper no 2010/27*, European University Institute, Florence.
- [42] Naudé, W.A. (2010d) Promoting Entrepreneurship in Developing Countries: Policy Challenges', *UNU Policy Brief, number 4*, 2010. Tokyo: United Nations University.
- [43] Naudé, W.A. (2010e). 'Entrepreneurship, Global Development, and the Policy Challenge', *Harvard College Economic Review*, Spring, 4 (2): 24-25.
- [44] Naudé, W.A. (2010f). The Global Economic Crisis and Developing Countries: Impacts, Responses and Options for Sustainable Recovery, *Poverty & Public Policy*, 2 (2) : article 8.
- [45] Naudé, W.A., Gries, T., Wood, E. and Meintjes, A. (2008) 'Regional Determinants of Entrepreneurial Start-Ups in a Developing Country', *Entrepreneurship and Regional Development*, 20 (2): 111-124
- [46] Naudé, W.A. and MacGee, J.C. (2009). Wealth Distribution, the Financial Crisis and Entrepreneurship, *WIDER Angle Newsletter, March 2009*, available at : <http://ideas.repec.org/p/unu/wpaper/angle-feb-2009-b.html>

- [47] Naudé, W. A. and Rossouw, S. (2010). ‘Early International Entrepreneurship in China: Extent and Determinants’, *Journal of International Entrepreneurship*, 8 (1): 87-111.
- [48] OECD (2009). *Responding to the Economic Crisis: Fostering Industrial Restructuring and Renewal*. Paris: Organization for Economic Cooperation and Development.
- [49] Oviatt, B. M., and P. McDougall (1994). ‘Towards a Theory of New International Ventures’. *Journal of International Business Studies*, 24 (4): 45-64.
- [50] Ravallion, M. (2008). ‘Bailing out the World’s Poorest’. *World Bank Policy Research Working Paper 4763*. Washington, DC: World Bank.
- [51] Ritholtz, B. (2009). *Bailout Nation: How Greed and Easy Money Corrupted Wall Street and Shook the World Economy*. New York: Wiley.
- [52] Romer, P.M. (1987). ‘Growth Based on Increasing Returns Due to Specialization’, *American Economic Review*, 77(2): 56-62
- [53] Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5), 71–102.
- [54] Schultz, T. (1975). ‘The Value of the Ability to Deal with Disequilibria’, *Journal of Economic Literature*, 13(3): 827-46.
- [55] Stiglitz, J.E. and Weiss, A. (1981). ‘Credit Rationing in Markets with Imperfect Information’, *American Economic Review*, 71(3): 393-410.
- [56] Syrquin, M. (1988). ‘Patterns of Structural Change’ (In Chenery, H.B. and Srinivasan, T.N. eds. *Handbook of Development Economics*, volume 1. Amsterdam: Elsevier Science Publishers. Pp. 203-273)
- [57] Stiglitz, J.E. (2009). ‘The Anatomy of a Murder: Who Killed America’s Economy?’, *Critical Review*, 21 (2-3): 329-339.
- [58] Szirmai, A., Naudé, W.A. and Goedhuys, M. eds. (2010) *Entrepreneurship, Innovation and Economic Development*. Oxford: Oxford University Press - forthcoming
- [59] Syrquin, M. (1988). ‘Patterns of Structural Change’ (In Chenery, H.B. and Srinivasan, T.N. eds. *Handbook of Development Economics*, volume 1. Amsterdam: Elsevier Science Publishers. Pp. 203-273).
- [60] Taylor, J. B. (2009). ‘The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong’, NBER Working Paper 14631. Cambridge, MA: National Bureau of Economic Research.

## 7 Short Appendix:

### Appendix 1: Proof of proposition 1

Using the Ramsey Rule from optimal household decision (3), the optimal spread from banking decision (11), and the return on capital and hence the loan rate a new firm is able to pay (8), and the no profit condition in the banking sector we can solve for the the stationary growth rate of start-ups

$$\begin{aligned} \frac{\dot{N}_y}{N_y} &= \frac{\dot{C}}{C} = \frac{r^l (1 - \vartheta_y) - c_b - \frac{1}{\eta_D B} - \rho}{\Theta} \\ &= \frac{\left[ \frac{(1 - \vartheta_y)(1 - \alpha)}{\chi_y} \alpha^{\frac{1 + \alpha}{1 - \alpha}} c_y^{\frac{-\alpha}{1 - \alpha}} \right] (1 - \vartheta_y) - c_b - \frac{1}{\eta_D B} - \rho}{\Theta} \end{aligned}$$

### Appendix 2: Proof of proposition 2:

Portfolio decision for the value of international investment  $F$  in these INVs:

$$F = f(r^w, r^f)W$$

Number of firms that can be financed by  $F$  :

$$N_x^* = \frac{f(r^w, r^f)W}{\chi_x}$$

Number of INVs per unit of wealth:

$$\lambda = \frac{N_x}{W} = \frac{f(r^w, r^f)}{\chi_x}$$

$$N_x^*(t) = \lambda^*(r^w, \chi_x, \bar{c}_x, \vartheta_x, \eta_x) W(t)$$

Portfolio equilibrium and hence a stationary structure we obtain:

$$\frac{\dot{N}_x^*}{N_x^*} = \frac{\dot{F}}{F} = \frac{\dot{W}}{W}$$

### Appendix 3 Proof of proposition 3

From the definition of the surplus labour rate  $\delta_T = \frac{U}{L_T}$  and the absorption of labour in both sectors 18 we obtain

$$\begin{aligned} \delta_T &= \frac{U}{L_T} = \frac{\bar{L}}{L_T} - \frac{N_y}{L_T} (a_y + 1) - \frac{N_x}{L_T} (a_x + 1) - 1 \\ \dot{\delta}_T &= -\frac{(a_y + 1) N_y(t) \dot{N}_y}{L_T N_y} - \frac{(a_x + 1) N_x(t) \dot{N}_x}{L_T N_x} \end{aligned}$$

If the poverty gap is defined by  $\varepsilon_T = \bar{w}_T - \frac{\bar{w}_T \bar{L}_T}{\bar{L}_T + U}$  and the subsistence wage is normalized we obtain by rearrangements

$$\begin{aligned} &= \frac{\bar{w}_T \bar{L}_T + \bar{w}_T U - \bar{w}_T \bar{L}_T}{\bar{L}_T + U} \\ \varepsilon_T &= \frac{\delta_T}{1 + \delta_T} \\ \frac{\dot{\varepsilon}_T}{\varepsilon_T} &= \frac{\delta_T}{1 + \delta_T(t)} \frac{\dot{\delta}_T}{\delta_T} - \frac{\delta_T \delta_T}{(1 + \delta_T(t))^2} \frac{\dot{\delta}_T}{\delta_T} \\ \frac{\dot{\varepsilon}_T}{\varepsilon_T} &= [1 - \varepsilon_T(t)] \frac{\dot{\delta}_T}{\delta_T} \end{aligned}$$

#### Appendix 4 Proof of proposition 4

From equation 13 we take the derivatives and obtain

$$\begin{aligned} a) \quad \frac{d\frac{\dot{N}_y}{N_y}}{d\chi_y} &= -\frac{1}{\Theta} \frac{(1 - \vartheta_y)^2 (1 - \alpha)}{\chi_y^2} \alpha^{\frac{1+\alpha}{1-\alpha}} c_y^{\frac{-\alpha}{1-\alpha}} < 0 \\ \frac{d\frac{\dot{N}_y}{N_y}}{d\bar{c}_y} &= \frac{-\alpha}{1 - \alpha} \frac{1}{\Theta} \frac{(1 - \vartheta_y)^2 (1 - \alpha)}{\chi_y} \alpha^{\frac{1+\alpha}{1-\alpha}} c_y^{\frac{-\alpha}{1-\alpha}} < 0 \\ \frac{d\frac{\dot{N}_y}{N_y}}{d\vartheta_y} &= -\frac{1}{\Theta} \frac{(1 - \vartheta_y)(1 - \alpha)}{\chi_y} \alpha^{\frac{1+\alpha}{1-\alpha}} c_y^{\frac{-\alpha}{1-\alpha}} < 0, \\ \frac{\dot{N}_y}{N_y} &= \frac{1}{\Theta} \left[ \frac{(1 - \vartheta_y)^2 (1 - \alpha)}{\chi_y} \alpha^{\frac{1+\alpha}{1-\alpha}} c_y^{\frac{-\alpha}{1-\alpha}} - c_b - \frac{1}{\eta_D \tilde{B}} - \rho \right] \end{aligned}$$

For the parameters for the banking sector we obtain by using equation 12

$$\begin{aligned} b) \quad \frac{d\frac{\dot{N}_y}{N_y}}{dc_b} &= -\frac{1}{\Theta} < 0, \\ \frac{d\frac{\dot{N}_y}{N_y}}{dB} \frac{dB}{d\bar{c}_b} &= -\frac{1}{\Theta} \frac{1}{\eta_D \tilde{B}^2} \frac{D_{b0}}{\bar{c}_{b0}^2 \eta_D} = -\frac{1}{\tilde{B} \bar{c}_{b0}} < 0 \end{aligned}$$

Effects on surplus labour and the poverty gap

$$\begin{aligned} \delta_T &= \frac{U}{\bar{L}_T} = \frac{\bar{L}}{\bar{L}_T} - \frac{N_y}{\bar{L}_T} (a_y + 1) - \frac{N_x}{\bar{L}_T} (a_x + 1) - 1 \\ \dot{\delta}_T &= -\frac{(a_y + 1) N_y(t)}{\bar{L}_T} \frac{\dot{N}_y}{N_y} - \frac{(a_x + 1) N_x(t)}{\bar{L}_T} \frac{\dot{N}_x}{N_x} \\ \frac{d\dot{\delta}_T}{d\frac{\dot{N}_y}{N_y}} &= -\frac{(a_y + 1) N_y(t)}{\bar{L}_T} < 0, \end{aligned}$$



$$\begin{aligned}\frac{\dot{\varepsilon}_T}{\varepsilon_T} &= [1 - \varepsilon_T(t)] \frac{\dot{\delta}_T}{\delta_T} \\ d\frac{\dot{\varepsilon}_T}{\varepsilon_T} &= \frac{[1 - \varepsilon_T(t)]}{\delta_T(t)} d\dot{\delta}_T\end{aligned}$$

### Appendix 5 Proof of proposition 5

From the optimal choice  $\lambda^* = \frac{N_x^*}{W} = \frac{f^*(r^w, r^f)}{\chi_x}$ , the the internal return of exporting start-ups  $r^f$  (see 17) and the an exogenous wealth path

$$N_x^*(t) = \lambda^*(r^w, \chi_x, \bar{c}_x, \vartheta_x, \eta_x) W(t)$$

$$\begin{aligned}\lambda^* &= \frac{N_x^*}{W} = \frac{f^*(r^w, r^f)}{\chi_x} \\ \frac{\partial f^*}{\partial r^f} &> 0, \quad \frac{\partial f^*}{\partial r^w} < 0.\end{aligned}$$

$$\begin{aligned}\frac{dN_x^*(t)}{dr^w} &= \frac{W(t)}{\chi_x} \frac{\partial f^*}{\partial r^w} < 0 \\ \frac{dN_x^*(t)}{dW} &= \lambda^* > 0\end{aligned}$$

### Appendix 6 Proof of proposition 6

After the shock  $N_x(0) > N_x^*(0)$ . Hence there is some time needed until the optimal number of firms crosses the already existing. If the potential optimal number is growing with the stationary rate of wealth accumulation we can determine the duration of this adjustment process in which no additional firms are financed,  $\dot{N}_x = 0$  :

$$\begin{aligned}N_x(0) - N_x^*(0) &= N_x^*(0) e^{\frac{\dot{W}}{W}t} \\ \ln(N_x(0) - N_x^*(0)) &= \ln N_x^*(0) + \frac{\dot{W}}{W}t \\ \tau &= \frac{\ln(N_x(0) - N_x^*(0)) - \ln N_x^*(0)}{\frac{\dot{W}}{W}}\end{aligned}$$

### Appendix 6 Proof of proposition 7

From the optimal choice  $\lambda^* = \frac{N_x^*}{W} = \frac{f^*(r^w, r^f)}{\chi_x}$ , the the internal return of exporting start-ups  $r^f$  (see 17) and the an exogenous wealth path

$$\begin{aligned}N_x^*(t) &= \lambda^*(r^w, \chi_x, \bar{c}_x, \vartheta_x, \eta_x) W(t) \\ \lambda^* &= \frac{f^*(r^w, r^f)}{\chi_x} \quad \text{with} \quad \frac{\partial f^*}{\partial r^f} > 0\end{aligned}$$

$$\frac{dN_x^*(t)}{d\eta_x} = \frac{W(t)}{\chi_x} \frac{\partial f}{\partial r^f} \frac{dr^f}{d\eta_x} < 0$$

since

$$\begin{aligned} \frac{d}{d\eta_x} \left( \frac{1 - \vartheta_x}{\chi_x} \frac{1}{\eta_x} \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right)^{1 - \eta_x} \right) &= \frac{d}{d\eta_x} \left( \frac{1 - \vartheta_x}{\chi_x} \frac{1}{\eta_x} \exp \left[ (1 - \eta_x) \ln \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right) \right] \right) \\ &= \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right)^{1 - \eta_x} \frac{1 - \vartheta_x}{\chi_x \eta_x} \left[ \left[ -\ln \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right) - \frac{1}{\eta_x} \left( 1 + \frac{1 - \eta_x}{(1 - \frac{1}{\eta_x}) \eta_x} \right) \right] \right] \\ &= \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right)^{1 - \eta_x} \frac{1 - \vartheta_x}{\chi_x \eta_x} \left[ -\ln \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right) \right] < 0 \end{aligned}$$

$$\frac{dN_x^*(t)}{d\bar{c}_x} = \frac{W(t)}{\chi_x} \frac{\partial f^*}{\partial r^f} \frac{(1 - \eta_x)(1 - \vartheta_x)}{\chi_x} \frac{1}{\eta_x} \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right)^{-\eta_x} < 0 \quad \text{for } \infty > \eta_x > 1$$

$$\frac{dN_x^*(t)}{d\vartheta_x} = -\frac{W(t)}{\chi_x} \frac{\partial f^*}{\partial r^f} \frac{1}{\chi_x} \frac{1}{\eta_x} \left( \frac{c_x}{1 - \frac{1}{\eta_x}} \right)^{1 - \eta_x} < 0$$