Economic Studies 119

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Development, Education and Entrepreneurship

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UPPSALA
UNIVERSITET

Department of Economics, Uppsala University

Visiting address: Kyrkogårdsgatan 10, Uppsala, Sweden
Postal address: Box 513, SE-751 20 Uppsala, Sweden
Telephone: +46 18 471 11 06
Telefax: +46 18 471 14 78
Internet: http://www.nek.uu.se/

ECONOMICS AT UPPSALA UNIVERSITY

The Department of Economics at Uppsala University has a long history. The first chair in Economics in the Nordic countries was instituted at Uppsala University in 1741.

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Preface

Robin Douhan died at the age of 31 in August 2009. Robin's death was caused by sudden heart failure and came as a deep shock to family, friends and colleagues.

Robin had obtained an unusually broad education before joining the PhD program in Economics at Uppsala University. He had studied Mathematics, Philosophy, Psychology and Sociology at Uppsala as well as Economics at the Stockholm School of Economics. I had the privilege to be Robin's PhD supervisor and I was impressed by his breadth of knowledge as well as his analytical rigor.

Robin's research interests were centered on economic growth, education and entrepreneurship. Robin had also strong interests in Economic Philosophy and Economic Methodology. Robin's thesis work was financed through the Research Institute of Industrial Economics (IFN) in Stockholm and Robin shared his working time between Uppsala and IFN.

This book includes five of Robin's papers. Robin had other papers in the pipeline and we don't know exactly how the final thesis would have appeared, had Robin had a chance to finish it. The plan was that Robin should defend his thesis in early 2010. It is depressing that such a promising life should be cut so short.

Uppsala, September 2009

Bertil Holmlund

Professor and Chairman of the Economics Department

Essay I

Is the Elephant Stepping on its Trunk? - The Problem of India's Unbalanced Growth*

Robin Douhan
Uppsala University,
Research Institute of Industrial Economics

Anders Nordberg
Uppsala University

November 21, 2008

Abstract

It is often assumed that recent success in the high-technology software industry will lead India's development. However, evidence suggest that basic manufacturing industry is stagnant. This paper proposes a mechanism that ties these two trends together. A big-push type of model, featuring linkages between firms, demand spill-over, and technology choice is elaborated. By imposing different cost structures on the manufacturing and high-technology industries the model describes outcome in terms of distribution between sectors. It is found that a policy which promotes a high-technology sector can have negative effects on the manufacturing industry as well as aggregate income. Directing resources towards infrastructure, on the other hand, benefits all sectors and increases aggregate income. The results from the model are found to correspond with the recent development pattern in India.

Keywords: L16, O14, O25
JEL classification: Industrialization, India, Industrial Structure

*We are grateful for useful comments from Johan Almenberg, Nils Gottfries, Bertil Holmlund, Fredrik Sjöholm, and participants in seminars at the Department of Economics at Uppsala University and the Research Institute of Industrial Economics.

1 Introduction

This study explores economic growth due to spill-overs between sectors in light of the empirical regularity that has become known as the stages of development. According to this regularity a country passes through three distinct stages on its way to becoming developed. In the transition from the first to the second stage the agricultural sector's share of aggregate income decreases while the manufacturing share increases. The transition from the second to the third stage entails a decline in the share of manufacturing in aggregate income and an expanding service sector.

The vast majority of countries that have a successful record of development have followed this pattern. Our study focuses on a country which stands on the brink of commencing an overarching economic development. At the beginning of the 21st century India became one of the fastest growing economies in the world. In accordance with the general pattern outlined above, the share of agriculture decreased. However, this was due to an expanding service sector rather than an expanding manufacturing sector. Moreover, a substantial part of the growth in services emanates from a fast growing high-technology information industry which is modern even by western standards.

In this sense, it seems as if India is skipping a whole stage of development. Is it possible for a country to successfully sidestep the general pattern of development stages? We analyze this question by asking to what extent the success in the service sector can lead an economy-wide progress that includes the manufacturing industries. A number of circumstances seem to point in favour of such spill-over effects. Profits and wage incomes from successful firms create a demand for other products. Advances in technology and production methods could be used to make manufacturing processes more efficient. Moreover, leading high-tech firms show success stories and provide role-models for others to follow.

Our intention is not to deny the validity of the above mentioned mechanisms. However, we believe that there are other factors that may dampen these effects. The reasons for these doubts are that, from a perspective of development stages, what happens at one stage gears the economy towards further development. The transition from an agricultural to a manufacturing economy creates a demand for investment in basic infrastructure such as railways, roads, harbors and communication systems. But it is likely that service industries, and especially high-technology industries, do not have the same needs. In this respect, a success in the service industry does not necessarily facilitate growth in manufacturing. Another case in point is the education system where an expansion of the first and second tier can be viewed as a response to the demands of an manufacturing industry. However, a high-technology sector primarily demands labor with tertiary education. For a country such as India, where the first and second tiers of education are badly in need of more resources, this creates a problem which also encompasses the prospects of manufacturing industries. Another argument concerns the consequences of service industries acting as subcontractors to manufacturing industries. If the service industry does not have a corresponding demand for manufacturing products, positive effects on manufacturing due to demand spill-over will be weaker. All these factors point to the possibility that the success of the information technology industry comes at the expense of other sectors, or at least that beneficial spill-over effects are less pronounced.

The aim of this paper is first to map out the situation in India and to frame the problem in a suitable theoretical approach. Second, we elaborate a model to describe what we believe to be a central mechanism in this development. In some simple policy experiments we try to demonstrate that a policy directed at promoting a high technology service sector has negative growth implications. However, in this static setting we also find that there is an optimal level of government involvement.

The paper is organized as follows. Section 2 describes the recent development of the Indian economy with regards to manufacturing and high technology services. In section 3 we frame our problem and discuss related research. Section 4 develops and solves the model. In section 5 and 6 the results are discussed and put in context. Section 7 concludes.

2 India's growth experience

From 1960 to 2003 India's growth in real per capita GDP was stagnant at about 2.5 percent per annum, giving rise to ideas about a Hindu-rate of growth. After the reforms of 1991 the average growth rate (up to 2003) was above 3.5 percent increase in per capita GDP. The trend in recent years has been an accelerating growth at 6 percent or higher.[1]

Over the long period real output from both manufacturing and services has increased, the former with a factor 6 and the latter with a factor 8, suggesting a service led growth. However, the wide aggregate of services hides a very diverse set of activities.[2] From here on we will focus on the high-

[1] The growth rate in per capita GDP for 2005 was 7.75 according to figures from *World Development Indicators*.

[2] Services has for a long time had an unproportional share in India's industrial structure (Hansda, 2002). The implications of this have been debated since independence. We maintain that the implications of high-technology services growth can be analyzed

technology segment of the service industry. This is the type of production which fits best into the development-stage framework since it bears evidence on India's move into the third stage.

2.1 High-technology service industries

The recent boom in the Indian information technology (IT) industry has spurred hopes that the stagnant growth pattern can be broken (e.g. Srinivasan, 2004). In their study of the 'revolution' in services Gordon and Gupta (2004) put business services, a category which includes IT, at the top of their list of fast growing service sectors. According to NASSCOM, the Indian National Association of Software and Service Companies, information technology and information technology enabled services increased their share of GDP from 1.9 percent in 1999/2000 to a projected share of 4.8 percent in 2006.[3] Although activities are increasingly geared towards more advanced services, it should be noted that a large portion of the firms are still call-centers, back-offices and the like. However, what is important for our purposes is the fact that in a developing country such as India a modern, high-technological industry plays an increasingly important role.

An educational system that favors higher education, and a resulting large reserve of scientists and engineers, stands out among the proposed explanations for India's success in the IT industry (Arora and Athreye, 2002). Other reasons commonly mentioned are facilitating policies from the government, preferential labor market and import/export regulation and foreign connections in the form of a large diaspora (see Kapur, 2002, for a typical exposition). Considering India's poor infrastructure, it is also important that the physical infrastructure needed for IT is more easily clustered. The establishment of Software Technology Parks, where firms are provided with communication facilities, spread all over India, is evidence of government involvement and of the feasibility of clustering.

2.2 Manufacturing

Kochhar *et al.* (2006) document disappointing tendencies in the development of Indian manufacturing. The manufacturing sector, with the exception of some industries demanding high-skilled labor, is lagging behind the recent growth trend. In view of India's enormous pool of low-skilled labor, this is a puzzling fact. Figure 1 gives an illustration of this disappointing growth in

independently of this historical fact.

[3] *Factsheets* published on http://www.nasscom.in/

Indian manufacturing. The solid line shows a 5-year moving average of the growth rate in Indian manufacturing, the dotted line shows the corresponding per capita values. A crude sketch of the post independence (1947) Indian history can be made by a three-fold division (Kaushik, 1997). First there was an initial push towards industrialization following independence, during the rule of Jawaharlal Nehru.[4] Then, quasi-socialist policies became a burden, and the overly controlled economy was stagnant up until the decade before the famous reforms of 1991.[5] In the 1980s industrialization gained momentum and there were several years of sustained high growth. But, as can be seen from figure 1, India has not managed to maintain this high level of growth.

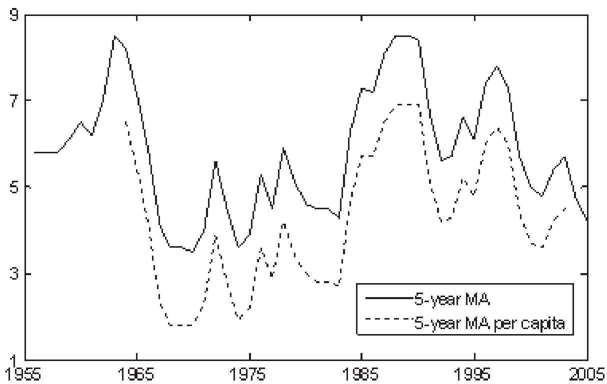

Figure 1: Growth in India's Manufacturing Output

3 Framing the problem

Our hypothesis is that the developments in the high-tech sector and the manufacturing sector are causally related. In one sense, this is trivially true. As we have seen, government policies have favored the growth of a high-tech service sector both through long term policies regarding education and recently also through more directed policy measures. But why did this success not

[4] For a discussion of the so called Mahalanobis plan see Nurkse (1957).

[5] The fact that growth started to accelerate years before the reforms were enacted is analyzed in Rodrik and Subramanian (2004).

spill over to the manufacturing sector? Why has an increased economic activity not generated growth in the low-end manufacturing sectors? Here, India with its vast pool of unskilled labor appears to have an obvious comparative advantage.

Our argument is not that there is something worrying about the strong development of high-technology services *per se*. However, there are plausible causal mechanisms that tie this positive development to the less convincing performance of the manufacturing sector.[6,7]

1. It is commonly recognized that investment in infrastructure is badly needed in India (Tonkin *et al.* 2006). There are several reasons why it is easier for a high-technology service firm than for a manufacturing firm to handle these shortcomings. First of all, investment in telecommunications and fast speed computer communication are less costly than hard infrastructure such as roads and railways (Kapur, 2002). As for electricity supply, special regulation allowed information technology industries to build their own generating capacity (Arora and Athreye, 2002). Secondly, the infrastructure required for production of services can more easily be clustered thereby lowering fixed costs. In view of the success of the service industry there is a risk that resources are channelled away from the kind of infrastructure that would further the development of a manufacturing industry. The argument here is that the success of the service industry tends to reduce political pressure for overall infrastructural investments, or at least channel it in other directions.

2. Reforms of education are not being undertaken. One of the prime explanations for India's success in information technology is the great reserve of qualified engineers. It is a well known fact that India has always had a relatively well endowed and well functioning educational system at the tertiary level. However, it is also well known that this has come at the expense of primary and (especially) secondary education

[6] Some researchers, e.g. Gordon and Gupta (2004), tend to interpret the data differently. They see the current stagnation in industry and the fast growing service sector as evidence that India has reached the third stage of development. However, considering that India's per capita GDP is about 2 percent of OECD average, we argue that it can hardly be maintained that India has reached an industrialized stage of development. In this regard, it can also be mentioned that in 1995 agriculture employed about 2/3 of the workforce.

[7] The notion that underdeveloped economies might skip technological steps taken by previously industrialized economies has been given the label "leapfrogging" in the literature. The prototypical example is when a country goes from having no telephones into using mobile phones (Stough *et al.* 2005).

(Rao *et al.*, 2003).[8] An increased demand for higher education from service sectors could potentially cement this malignant pattern.[9] The argument here is that the poor quality of the primary and secondary schools hurt manufacturing the most by lowering the productivity of the workforce in that sector (Bosworth and Collins, 2007).

3. There are fewer and less strong backward linkages from service sectors to manufacturing sectors than in the other direction. This means that service industries have less need to buy intermediate inputs from other industries (outside the service sector) than manufacturing industries. The linkages in the Indian economy have been studied by Banga and Goldar (2005) and Hansda (2002). Although they find evidence of linkages in both directions, Hansda stresses that backward linkages from the service sector are weaker than the forward linkages (sales to other sectors). If the service sector is not generating a demand elsewhere in the economy then it will not increase market potential of manufacturing goods.

A predominant idea in the structuralist framework, which we will subscribe to in this study, is that what happens at one stage of development can be said to prepare, or lay the foundation for, subsequent development. At an abstract level, this is the essence of the problems above.[10] For instance, during the development phase where manufacturing expands, physical infrastructure is built up, partly as a response to demand from producers.

Export demand is an obvious explanation for the emergence and much of the subsequent growth in the IT sector, which we disregard from in our model. Based on demand for exports it could still be argued that the high tech service sector will continue to develop independently of manufacturing. In this regard, it is our contention that such pattern is highly unlikely to

[8] One indication of this pattern comes from literacy rates. Bosworth and Collins (2007) report literacy rates (ages 15-24) of 76 percent in India compared to 99 percent in China.

[9] Some studies have indicated that primary and secondary schooling are more important propellants of growth than higher education (Self, 2004). Other find that secondary education is the key education variable in explaining growth convergence between Indian states (Trivedi, 2002). However, in general there is little consensus regarding the relationship between education and growth (Temple, 2001).

[10] The explanation for the poor performance in manufacturing proposed by Kochar *et al.* (2006) is that increases in labor cost are spilling over to manufacturing industry. Although intensive in low-skilled labor lower end manufacturing also has a need to employ more qualified staff such as managers, administrative personnel and production engineers. Hence, increased wage cost for high-skilled labor also hurt the competetiveness of manufacturing. This a price-effect that we will abstract from in our analysis.

sustain growth in the long run. In a country the size of India's, domestic demand is arguably crucial.[11]

It is instructing to compare India with South Korea, which is one of the prime examples of successful export led growth (Westpahl, 1990). Korean industrial policy in the 1960s primarily focused on facilitating growth of internationally competitive export industries. A wide array of policies, from tax exemption to direct intervention, was implemented. Importantly, the protection also comprised domestic production of intermediaries used in the production of export goods. Similarly to India, external demand was a key in Korea's accelerated growth. What separates the two cases is the way that this demand spilled over into other sectors. In this respect it is arguably critical that Korea managed to secure complete production chains.

Another problem in our study is how growth in manufacturing can be achieved. It is our contention that manufacturing is not suffering from absence of comparative advantage in relation to the high tech sector. A more appropriate view is that of a bottleneck problem involving high fixed costs. Our model captures these costs in terms of underdeveloped infrastructure. However, equally important explanations can arguably be found in the labor regulations, high import and export tariff and other institutional constraints that remains even after the deregulation wave starting in 1991 (Kohli, 2006; Ahluwalia, 2002). Our model abstracts from differential effects due to regulation on growth in manufacturing and high-tech services.

3.1 Related Research

Three distinct strands of theory dealing with the industrialization process can be discerned. The most recent is the new economic geography/trade theory. Monopolistic competition models with transport costs are used to show that once a certain critical mass, in the form of either technological or pecuniary externalities, has been reached an agglomeration process starts (Krugman, 1981; Krugman and Venables, 1995; Markusen, 1989). In a multilateral trade setting, countries can differ with respect to stage of development due to varying transport costs (Baldwin *et al.*, 2001).[12]

Second, in the traditional neoclassical capital accumulation theory, the key components are capital and technology. A country develops through accumulation of physical and human capital. Due to diminishing marginal productivity of capital, growth eventually comes to a halt where only technological progress can generate further growth (Solow, 1956). Later research

[11] A similar argument is presented by Wu (2007).

[12] A recent study is McLaren (2000) who shows that industrial structure is closely linked to the openness of an economy.

has integrated technological choice to show the possibility of different levels of industrialization (e.g. Parente and Prescott, 1994; Zilibotti, 1995).[13]

The third strand of theory, which we believe to be most relevant to our problem, is the structuralist branch (Chenery, 1975). An early study is Kuznets (1957), who concluded that the long term trends in the industrial structure of a growing economy were remarkably similar to the cross section differences between countries with different per capita income. It is now common practice to associate the stages of development with the sectoral divide between agriculture, manufacturing and services (Rostow, 1971).

Kuznet's conclusion was that economic development is associated with an increase in the share of manufacturing and a decline in the share of agriculture. However, the development of the service sector was considered less clear cut (see Chenery, 1960). A more modern account of development stages includes a step where manufacturing stagnates and services grow (Kongsamut, *et al.*, 2001).

Another common ingredient of the structuralist tradition is the emphasis on linkages between sectors (Hirschman, 1958) and chains of input and demand spill-over (Rosenstein-Rodan, 1943). The modern and formal interpretation of these arguments is 'Increasing returns' or 'Big Push' models.[14] The study by Murphy *et al.* (1989) has been influential for the rather small literature that combines increasing returns with linkages between different producers. The basic idea is that firms can choose to implement an increasing returns technology. Fixed cost associated with this mode of production is prohibitively expensive for the individual firm. Murphy *et al.* (1989) demonstrated that an adoption of the new technology was possible only by coordinating the implementation across many sectors. The demand spill-over due to higher total output then helps more firms to overcome the fixed cost.

Fafchamps and Helms (1996) analyze vertical linkages between intermediate inputs. They show that intermediate input demand combined with a high income elasticity for industrial goods can generate multiple equilibria. In a similar framework, Gans (1997; 1998a,b) discusses the fixed cost assumption. Fixed costs can enter either as overhead labor cost or as a deduction from output. Gans (1997) shows that the choice of specification is not crucial for generating multiple equilibria. The most recent contribution to this literature is Ciccone (2002). His model features horizontal intermediate demand

[13] For instance Rioja (1999) and Esfhani and Ramírez (2003) incorporate infrastructure as a public good to demonstrate the existence of an optimal level of infrastructural investment.

[14] Describing industrialization specifically as adoption of increasing returns to scale production has been an influential idea (e.g. Young, 1928; for a survey see Matsuyama, 1995)

linkages between industrial firms. From a technical point of view this is also our main source of inspiration.

In the next section, we build a model using the structuralist framework as developed by Ciccone (2002). Central to our analysis is how firms adopt different kinds of technologies, and how this is affected by interconnections between sectors. To make the analysis tractable we simplify other aspects of the economic environment. The most stark contrast to neoclassical models is that we will reduce the role of the price mechanism.

4 A model of industrialization

4.1 Outline of the model

The model has three sectors, denoted **A**(griculture), **M**(anufacturing) and **H**(igh technology). We will refer to **M** and **H** collectively as industrial sectors. Firms in these sectors are characterized by monopolistic competition, increasing returns to scale and the use of intermediates. **A** firms, also referred to as pre-industrial firms, have a constant returns to scale technology and use only labor as input.

We set up the model in three steps. First we follow Ciccone (2002) closely and build a model with only the two sectors **A** and **M**. We do this to show that it is possible to construct an equilibrium where some but not all firms have industrialized. In a second step, we allow different industrial technologies, i.e. we add the **H** sector. Finally, we introduce a government in order to study the effects of different policies.

Goods and firms are defined on a segment of the real line. Hence, there is a continuum of goods, each indexed by the real number $m \in [0, 1]$. If $m' < m''$, we say that m' is upstream of m''.

The first model generates an outcome where the n firms furthest upstream industrialize, i.e. are **M** firms. The other $1 - n$ remain in the pre-industrial stage, i.e. are **A** firms (figure 2). An industrial firm buys input from each industrial firm upstream (firm $m' \leq n$ buys from all $m < m'$).

In the extended model with two industrial sectors, the **H** sector lies on the interval $\left[0, n^H\right]$, the **M** sector on the interval $(n^H, n^M]$, and the **A** sector on $(n^M, 1]$ (figure 3). Again, an industrial firm uses input from all other firms upstream of its own position, i.e. **M** firms buy from both **M** and **H** firms, whereas **H** firms only buy from other **H** firms.

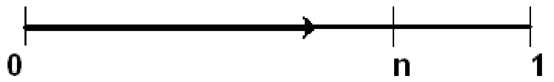

Figure 2: Structure with one industrial sector

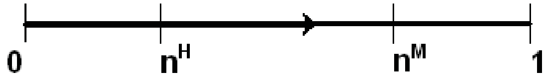

Figure 3: Structure with two industrial sectors

4.2 Basics

There is a measure L of households. The utility function of the representative household is specified as

$$U(c) = \int_0^1 \ln c(m) dm.$$

Where $c(m)$ is consumption of good m. Preferences over consumption goods are symmetric and the elasticity of substitution between different goods is unity. Assuming identical prices, households consume an identical amount of each good. On the supply side, each household inelastically supplies one unit of labor. Labor is the only resource and wages the only compensation to production factors. Apart from wages, households get additional income from firm's profit. Firms in the **A** sector produce one unit of output using one unit of labor. Hence, marginal cost of production is equal to wage. **A** firms are assumed to be perfectly competitive.

The industrial firm indexed m (either **M** or **H**) assembles a composite $z(m)$ of other industrial goods. In a second step, this composite is used together with labor to produce an intermediate good $x(m)$.

$$\ln z(m) = \ln m + \frac{1}{m}\int_{i=0}^{m} \ln x(i,m)di \quad (1)$$

$$\ln x(m) = \ln B + \beta \ln z(m) + (1-\beta)\ln l(m) \quad (2)$$

The aggregation function (6) is designed to have constant returns in x and to increase in m.[15] The production function (2), has a standard Cobb-Douglas form. The parameter $\beta \in (0,1)$ determines the relative factor shares of $z(m)$ and $l(m)$, and will be referred to as intermediate intensity input in industrial firms. The constant B is set so as to normalize the marginal product.[16] As a consequence, all firms have the same marginal cost. Set wage as numeraire ($w = 1$), to get unit marginal cost for all firms.

The final output $y_O(m)$ is produced using the intermediate good $x(m)$,

$$y_O(m) = \frac{1}{\theta}x(m) - f(m). \quad (3)$$

Where $\theta \in (0,1)$ is an technology efficiency parameter. The function $f(m)$ is a fixed cost, which is assumed to be increasing, $f'(m) > 0$. We use a first degree polynomial to describe this cost.[17] In the first model, with only **M** as industrial firms, the constant terms is omitted, and we have $f(m) = \phi m$.

Industrialization is described as a process in which **A** firms are replaced by **M** firms. This has two main effects. First, production is carried out more efficiently, due to the parameter θ. Second, the structure of production changes, as firms are linked together by intermediate input usage. The density of these interconnections is governed by the parameter β. For each good, the criterion for adopting the industrial technology by changing from **A** to **M** will ultimately depend on the demand for a firm's output, its fixed costs and the efficiency parameter θ. Since fixed costs are increasing in m, the further

[15] Dividing the integral by m ensures that we have CRS. And adding the logarithm of m yields a log-linear increase of $z(m)$ in m. If identical amounts (x^*) of each intermediate is used we have $z(m) = mx^*$.

[16] Equal marginal products of $z(m)$ and $l(m)$ gives $z(m) = \frac{\beta}{1-\beta}l(m)$. Substitute this into (2) to get $x(m) = B\left(\frac{\beta}{1-\beta}\right)^{\beta} l(m)$, which is solved for $l(m) = \frac{x(m)}{B}\left(\frac{\beta}{1-\beta}\right)^{-\beta}$ Under identical prices $w = p = 1$, the cost of $x(m)$ can be expressed as $Cost = l(m) + z(m) = l(m)\left(1 + \frac{\beta}{1-\beta}\right)$. Substitute $l(m)$ for $x(m)$ to get $Cost = \frac{x(m)}{B\beta^{\beta}(1-\beta)^{1-\beta}}$. Now we can set B so as to get a denominator equal to 1. This implies unit marginal and average cost of $x(m)$.

[17] Ciccone (2002) assumed constant fixed costs. Given this formulation once the first firm industrialized all others will follow. This follows from an increasing demand when more firms industrialize.

downstream the higher the cost of adopting the industrial technology. The rationale for this assumption, which will be discussed in more detail in section 5.1, is that coordination costs are higher when more intermediates must be shipped from different suppliers. The parameter ϕ will be interpreted as a cost which is dependent on the quality of infrastructure.

4.3 Profit and Demand

The perfectly competitive **A** firms set price equal to 1. We add the assumption that the markup of an industrial good has an upper cap. Each good can potentially be produced by **A**, **M** or **H** firms. If a monopolistic **M** or **H** firm sets its price above 1, it is assumed that an **A** firm enters and undercuts this price. Hence, the **A** firms constitutes a competitive fringe.

Technology and preferences imply that industrial firms face unit elasticity of demand from consumers and intermediate input buyers. Hence, industrial firms maximize profit by setting as high price as possible, and thereby reach the upper price bound. Consequently, the price of labor, intermediate input and consumption goods from all types of firms is equal to one ($p = 1$).

Given these prices, we can use final output (3) to write the profit function of industrial firms as

$$\pi(m) = y_O(m) - x(m) = (1-\theta)y_O(m) - \theta f(m). \tag{4}$$

Let $y_D(m, n)$ denote the total demand for good m when n firms have industrialized. Since monopolistic industrial firms make profit on each unit sold, it will always meet demand, $y_O(m) = y_D(m, n)$.

Demand has two components, demand for consumption and intermediate input. Given that prices are identical, only demand for intermediate input will differ between goods. Denote consumption demand, given that n firms have industrialized $D(n)$. Demand for good m as an intermediate input can be written as the sum of demand from all industrial firms downstream of m. The total demand for input for an industrial firm is $\theta\left[y_O(m) + f(m)\right]$, from final output (3). A fraction β of this is intermediate input. Moreover, the firm indexed m supplies intermediate input to a natural number m firms downstream.[18] Hence, a firm supplies $1/m$ of its total intermediate supply to each downstream industrial firm. Given this, the demand for good m as intermediate input can be expressed as

$$y_D(m, n) = \int_0^m \frac{\beta}{i}\theta\left(y_D(i, n) + f(i)\right) di + D(n). \tag{5}$$

[18] Technically, n and m are measures, this causes conceptual problems which we ignore. For details we refer to Ciccone (2002).

Consumers spend all their income on consumer goods, therefore $D(n)$ must be related to aggregate income, which we denote by $Y(n)$. Given identical prices, and a unit elasticity of substitution, households will buy identical number of all goods. Therefore $D(n) = Y(n)$.

$$y_D(m,n) = Y(n)\left(\frac{n}{m}\right)^{\theta\beta} + \left[\phi n \frac{\theta\beta}{\theta\beta+1}\left(\frac{n}{m}\right)^{\theta\beta} + \frac{m\phi}{\theta\beta+1}\right] - m\phi. \quad (6)$$

The two parts within square brackets is the demand for m to cover fixed costs upstream.[19] Although firms incur a reduction in demand to cover its own fixed costs, demand is increasing in ϕ,[20] holding the level of industrialization constant. However, raising the fixed costs will move the frontier of industrialization upstream since fewer firms will now industrialize. This will cause demand for goods upstream as intermediates to decrease, and aggregate profits and income to fall.

Aggregate income is the sum of two components, labor income and profits from industrial firms. Due to inelastic labor supply and since the wage equal to 1, the former is equal to the exogenous L. We denote profits from industrialized firms by Π. From profit (4) and demand (6), the expression for aggregate profits is

$$\Pi = \int_0^n \left((1-\theta)\, y_D(m,n) - \theta f(m)\right) dm. \quad (7)$$

Given the identity $Y(n) = L + \Pi$, demand (6) and aggregate profit (7) we can solve for aggregate income as a function of the degree of industrialization,

$$Y(n) = \frac{\left(L - n\lambda\frac{\phi n}{2}\right)}{n\lambda + (1-n)}. \quad (8)$$

Where $\lambda = \left(\frac{1-\beta}{\frac{1}{\theta}-\beta}\right) < 1$. Note that we can divide by L to get a per capita expression. Aggregate income, and profits are all increasing in β and decreasing in θ.[21] If the intensity of intermediate input use or the efficiency increases (θ decreases), demand and profits will respond positively.

[19] To see this formally let $\hat{x}$ be the required output to cover fixed costs, then

$$\frac{d\hat{x}}{dm} = -\frac{\theta\beta\hat{x}}{m} + \phi.$$

When solved with initial condition $\hat{x}(n) = \phi n$ this yields the expression within the square brackets. Also note that we have to subtract the fixed costs in sector m from the demand for good m.

[20] $\frac{\partial y(m,n)}{\partial \phi} = \frac{\theta\beta}{(1+\theta\beta)}\left(n\left(\frac{n}{m}\right)^{\theta\beta} - m\right)$ and since $n > m$ this is allways > 0.

[21] This can be verfied using the fact that $\frac{\partial\lambda}{\partial\beta} < 0$ and $\frac{\partial\lambda}{\partial\theta} > 0$.

4.4 Equilibrium with two sectors

When analyzing the equilibrium, we use the concept of local stability.[22] An interior point $n \in (0, 1)$, will constitute an equilibrium if firms upstream of n make a profit using industrial technology, whereas firms downstream would incur a loss.[23] We are only interested in cases where some, but not all firms have undergone industrialization. This restriction follows from our ambition to construct a model which allows us to analyze changes in sector shares due to policy interventions; positive changes in these shares would of course be impossible if all firms had industrialized to begin with.

Production of the marginal good, n, must generate the same profit whether produced by an **A** or an **M** firm.[24] Since **A** firms are perfectly competitive and make zero profit, the same must be true for an **M** firms. By the profit function (4) we thus have:

$$y(n, n) = \frac{\theta\phi n}{(1 - \theta)} \tag{9}$$

We solve for the relationship between fixed cost parameter ϕ as a function of n. In condition (9), note that $y(n, n) = Y(n)$, and then substitute for $Y(n)$ using aggregate income (8). We then get an expression which can be solved for $\phi(n)$.

$$\phi(n) = \frac{2L(1 - \theta)}{n^2[\theta\lambda + \lambda - 2\theta] + 2n\theta}$$

Note that $\frac{\partial\phi(n)}{\partial n} < 0$, i.e. the requisite fixed cost parameter decreases when we allow industrialization to progress further. Since $\phi(n)$ is decreasing in n we can get a lower bound for the fixed cost parameter by setting $n = 1$. For some parameters θ and β we can pick a $\phi^*(\theta, \beta, L, n)$ such that $n < 1$. Then our conditions are met and we have a stable equilibrium in point n. This demonstrates that a partial industrialization outcome can be a locally stable equilibrium.

[22] For an rigorous analysis we refer to Ciccone (2002) and Krugman (1991).

[23] We here depart from Ciccone (2002), who analyzes three possible cases, pre-, full- and partial- industrial equilibrium. Since two former pertain to the big-push argument they have no relevance for our purposes.

[24] It is here assumed that a presumptive M firm does not internalize the effect of an expansion in demand due to his entry. There is a possibility that $\frac{d\pi(n)}{dn}|_{n=n^*} = (1 - \theta)Y'(n^*) - \theta\phi > 0$, given that we allow $Y'(n^*) \neq 0$. It can be shown that this will always hold as long as $\beta < \theta$.

4.5 Introducing choice of technology

We now introduce a new structure, with two types of industrial firms **M** and **H**. These firms differ with respect to technology and fixed cost structure. An industrial firm can produce the final good using a parameter θ_M which costs nothing or at a cost c use a more efficient technology θ_H, such that $0 \leq \theta_H \leq \theta_M \leq 1$. Since demand, and hence profit, is declining in m, the firms furthest upstream will profit the most by using the more efficient technology. This will generate an outcome where **M** firms use intermediate input from both **M** and **H** firms, whereas **H** firms use only goods produced by other **H** firms. The **H** sector will therefore be the interval $0 \leq m \leq n_H$, and the **M** sector the interval $n_H < m \leq n_M$.

4.6 Demand and profit functions

Begin with the **M** sector. As before we can find the demand for **M** goods by solving for $y_D(m, n_M)$. The demand facing firms in the interval $n_H < m \leq n_M$ is given by two parts. One is the demand from other **M** firms, and the other consumption demand. This can be expressed similar as in (5). For firms $m \in (n_H, n_M]$:

$$y_D(m, n_H, n_M) = \int_{n^H}^{m} \frac{\beta}{i} \theta_M \left(y_D(i, n_M) + f_M(i) \right) di + Y(n_M, n_H) \qquad (10)$$

Where $f_M(m) = \phi m$. And the total consumption demand $Y(n_H, n_M)$ is now dependent on the size of both the **M** and the **H** sector. For the **H** firms in the interval $0 \leq m \leq n_H$, demand can again be expressed as three components. Of these, demand from **M** firms and consumer can be summarized in one component which is equal to the demand facing the **M** firm furthest upstream. This is $y_D(n_H, n_M)$, which can be derived from (10). The third part is the demand from other **H** firms, which obviously also must lie in the interval $0 \leq m \leq n_H$. For firms $m \in [0, n_H]$:

$$y_D(m, n_H, n_M) = \int_{0}^{m} \frac{\beta}{i} \theta_H \left(y_D(i, n_H, n_M) + f_H(i) \right) di + y_D(n_H, n_M). \qquad (11)$$

Where $f_H(m) = c + \phi m$. Given demand in each sector, we can find the industrialized firm's profit. Integrating over the two sectors yield aggregate profits Π^H and Π^M. Aggregate income will consist of three parts, profits from the **H** and **M** sectors, income from labor:

$$Y(n_M, n_H) = \Pi^M + \Pi^H + L. \qquad (12)$$

Generally, aggregate profit can be written as

$$\Pi^M + \Pi^H = Y(n_M, n_H)A\left(\beta, \theta_M, \theta_H, n_H, n_M\right) + \phi B\left(\beta, \theta_M, \theta_H, n_H, n_M\right).$$

This can be substituted into aggregate income (12) and solved for $Y(n_M, n_H)$. Since A and B are nonlinear functions in most parameters, we only present numerical solutions.

4.7 Equilibrium with three sectors

The equilibrium of interest is one where the **H** sector has begun to develop but still not engulfed the **M** sector. Put formally this means that $n_M \in (0, 1)$ and $n_H < n_M$. As before the **M** firm furthest downstream, is indifferent to industrializing. In other words, this firm makes zero profits, yielding the condition:

$$(1 - \theta_M)y(n_M, n_M) - \theta_M f_M(n_M) = 0. \tag{13}$$

With two industrialized sectors, the **M** firm furthest upstream, i.e. closest to the **H** sector, must be indifferent to switching to the **H** technology. From the profit function (4) we get the following condition:

$$(\theta_H - \theta_M)y(n_H, n_M) + \theta_H f_H(n_H) - \theta_M f_M(n_M) = 0. \tag{14}$$

4.8 Policy Experiments

We now introduce a government in order to perform policy experiments. The government redistributes from aggregate income to either the **M** or the **H** sector. The revenue side of the government is a uniform flat tax on each households income. The expenditure side is a subsidy which lowers the fixed costs. The magnitude of government involvement is exogenously given.

A first experiment is to subsidize the cost of using the **H** technology θ_H. We introduce a subsidy τ, and each **H** firm now pays a fixed cost $f_{H,G1}(m) = (1 - \tau)c + \phi m$. Denote the total cost of this subsidy G. This gives us two restrictions, which together with condition (13), characterize the equilibrium:

$$(\theta_H - \theta_M)y(n_H, n_M) + \theta_H f_{H,G1}(n_H) - \theta_M f_M(n_M) = 0. \tag{15}$$

and

$$G = \tau c n_H.$$

A second experiment is to subsidize the cost ϕm, which is common to all industrialized firms. Again the size of the subsidy is given by a share τ of the fixed costs. Hence **M** firms now have a cost $f_{M,G2}(m) = (1-\tau)\phi m$, and **H** firms $f_{H,G2}(m) = c + (1-\tau)\phi m$. We have the conditions

$$(1-\theta_M)y(n_M, n_M) - \theta_M f_{M,G2}(m) = 0 \tag{16}$$

$$(\theta_H - \theta_M)y(n_H, n_M) + \theta_H f_{H,G2}(n_H) - \theta_M f_{M,G2}(m) = 0. \tag{17}$$

And the budget constraint for the policy maker is

$$G = \tau \int_0^{n_M} \phi m dm.$$

5 Results

5.1 Conceptual issues and Parameter values

The full model has three sectors, which differ with respect to (i) fixed costs, (ii) level of returns to scale, (iii) use of intermediates and (iv) supplies of intermediate goods to other firms.

The model features two types of fixed costs. The first pertains to the use of industrial technologies (**M** or **H**). These modes of production requires the use and combination of different intermediate inputs. The fixed cost captured by ϕ reflects the cost of coordination, which is increasing in the number of intermediates used. This provides the conceptual link to infrastructure. It is plausible that poor infrastructure is more costly as more intermediate goods have to be shipped geographically across the country and more contacts are needed between buyers and suppliers. The second cost is the cost of upgrading the industrial technology. This cost should be thought of mainly as an investment in human capital and skills needed to adopt the **H** technology.

Both of these costs are incurred at the firm level in order to make industrial production feasible. Here it is important to underscore that our model is designed to analyze a development economy, where there are substantial costs associated with low quality infrastructure and low levels of human capital. These costs must be covered in order for a production unit to establish. The empirical task of identifying these costs is by no means straight forward, but in principle they are observable entities. In solving the model, we will in practice treat these costs as residuals. The costs are set so as to achieve the desired distribution of sectors. Given the other parameters, ϕ and c will determine the size of **H** and **M**.

In our model it might seem counterintuitive that **H** has a higher degree of returns to scale than **M**. If the latter represents manufacturing we usually think of these firms as the prototype for increasing returns – especially processing of raw materials. However, the firms in our model has no degrees of freedom in making an output volume decision, but merely responds to a given demand. This means that a shift from the **M** to the **H** technology should be interpreted as a decision to shift to a more efficient technology rather than a decision pertaining to scale. Since this is one of the main driving mechanisms of our model we need the parameters θ_M and θ_H to be smaller than 1. We choose a moderate value of 0.9 for the **M** sector and a multiple 0.9 of this for the **H** sector.

The magnitude of the linkages is determined by the parameter β, which is set to 0.5. This can be compared to the share of value of intermediate inputs in US manufacturing which is approximately 0.67 (Bureau of Economic Analysis, 2002). We find it plausible that a developing country should have a somewhat lower degree of intermediate usage. Finally, the population size L is normalized to 1.

5.2 First results

A first step is to identify an appropriate cost parameter ϕ. This is done in the model with two sectors, **A** and **M**. Given the parameter specification, a lower bound for the fixed cost parameter ϕ is about 0.13, at which full industrialization is reached. When the fixed cost parameter is set equal to 0.4, aggregate income is 1.041 which is 4.1 percent above the baseline case with no industrialization. The industrialized sector comprises 29 percent of all goods. The fixed cost incurred by firms due to poor infrastructure is approximately 2 percent of aggregate income. We argue that this is a conservative estimate.

We now turn to the model with three sectors. The parameter c is added and set to 0.2. With this parameterization, aggregate income is 1.053 and 29.3 percent of all goods are produced with an industrial technology (**M** or **H**), and 9.9 percent with the **H** technology. Total fixed costs, accruing both to ϕ and c, are now 0.4. This cost falls almost equally on cost due to infrastructure (ϕ) and cost due to higher requirement of human capital (c). It is our presumption that this is as close to a neutral parameterization as we can come.

It is interesting to see how sensitive our parameterization of costs is to changes in the parameters, θ and β. Table 1 presents results for different values of β. For a given cost structure and technology, increasing the density of linkages affects the size of the **H** sector more than the **M** sector. Moreover, total income increases significantly without much change in the number of goods produced by industrial technologies (**M** or **H**). Demand for intermediates increases due to more dense linkages, this benefits firms upstream and makes it feasible to produce more goods with the **H** technology. However, the **M** firms furthest downstream only benefit from increase in aggregate income due to higher profits of other firms.

In table 2 the size of efficiency parameters θ_M is varied (keeping $\theta_H = 0.9\theta_M$). It is evident that the efficiency parameter is the main determinant of growth in the model. When the efficiency of both **M** and **H** technology improves, this increases the relative size of the **H** sector. Table 3 shows the effect of varying the difference between and θ_M and θ_H. As the **H** technology becomes relatively more efficient, it is possible for more firms to bear the fixed costs c.

	2 sectors			3 sectors		
β	0.25	0.5	0.75	0.25	0.5	0.75
$Y(n)$	1.024	1.041	1.089	1.025	1.053	1.132
n_M	0.284	0.289	0.302	0.283	0.292	0.313
n_H	–	–	–	0.026	0.099	0.174

Table 1: Sensitivity to variation in density of linkages

	2 sectors			3 sectors		
θ_M	0.80	0.9	0.95	0.80	0.9	0.95
$Y(n)$	1.240	1.041	1.010	1.298	1.053	1.011
n_M	0.775	0.289	0.133	0.814	0.292	0.094
n_H	–	–	–	0.532	0.099	0.029

Table 2: Sensitivity to variation in efficiency parameter

	3 sectors		
$\frac{\theta_H}{\theta_M}$	0.875	0.9	0.95
$Y(n)$	1.061	1.053	1.026
n_M	0.295	0.292	0.151
n_H	0.187	0.099	0.009

Table 3: Sensitivity to relative efficiency

5.3 Policy Experiments

Table 4 shows the effect of introducing a government of a size 0.02. In other words, the government raises taxes equal to about 2 percent of total income and uses these revenues to either subsidize infrastructure or supply of high-skilled labor. This is a modest size of a government, but bear in mind that its only role is to subsidize either infrastructure or high skilled labor supply. The government in the model should not be equated with a complete public sector. Moreover, the size of government is related to the fact that costs are also relatively small.

Variables	No Policy	Policy 1	Policy 2
$Y(n)$	1.053	1.039	1.072
n_M	0.292	0.289	0.498
n_H	0.099	0.283	0.176

Table 4: Policy Experiments

The difference between policy 1 and policy 2 in terms of effect on aggregate income is striking. Whereas policy 2 increases aggregate output by 1.8 percent, policy 1 actually decreases total income by 1.3 percent. Effects on positions of sector **M** and **H** are as expected, policy 1 promotes the **H** sector, but has a negative effect on the **M** sector. Policy 2 has positive effect on the size of both the **M** and **H** sector.

Next, we let government size vary from 0.001 (approximately 0.1 percent of the total income) to 0.02. Figure 4 plots the resulting paths for the **H** and the **M** sector, and figure 5 plots the development of total income. Policy 1 are associated with solid lines, and policy 2 with dashed lines. The two upper lines in figure 4 describes the **M** sector, and the lines below the **H** sector. Reducing the cost of skilled labor under policy 1 obviously boosts the development of an **H** sector, but as can be seen the effect on the **M** sector, as well as on total industrialization, is negative. Moreover, policy 1 reduces aggregate output (figure 5).

Directing government funds towards improvement of infrastructure, under policy 2, leads to an increase in both the **M** and **H** sector. The **M** sector increases faster than the **H** sector. This is due to the fact that the marginal **M** firm benefits more from the subsidy than the marginal **H** firm. The subsidy gives little incentive for a marginal firm to change from **M** to **H** technology, since the fixed cost $m\phi$ remains almost the same. Nevertheless, some firms do change since the fixed cost is produced more efficiently with the **H** technology. The effect on total income is positive. However, as can be seen in figure 5, total income increases at a decreasing rate.

Next, we explore two pertinent features of the two policies. First, why is aggregate income decreasing under policy 1? The second issue relates to the concavity of aggregate income in government size which suggests that there might be an optimal size of government involvement.

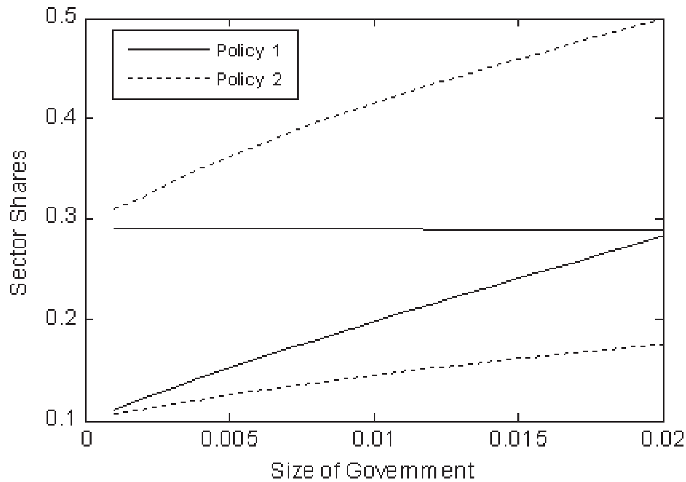

Figure 4: Location of M and H Sectors.

The detrimental effects that policy 1 has on total income at first seems strange. Under this policy, government revenues are used to subsidize **H** firms. The increased profits are distributed to consumers which should counteract the negative effect of the tax on consumer demand. However, the subsidy introduces several other distortions which lower aggregate income. We take policy 1 with a government size equal to 0.02 as an example. Consider first former **M** firms which changes to **H** technology. Due to the use of more efficient technology, revenues in these firms increase by 80 percent. However, cost increases by almost 210 percent since firms now also incur the cost c. The subsidy compensates for part of this increased cost, and allows firms to increase their profits by a total of 22 percent. However, from aggregate perspective, each unit of subsidy directed towards these firms generates only 0.78 units of profits. The same adverse effect is found in the firms which used **H** technology before the subsidy (and continues to do so), here each unit of subsidy generates an 0.68 increase in profits. Demand spillover between these firms falls as the government decreases the cost of using **H**. The old **H** sector is also affected negatively by the more efficient production downstream, this decreases demand for upstream goods as intermediates, and reduces profits

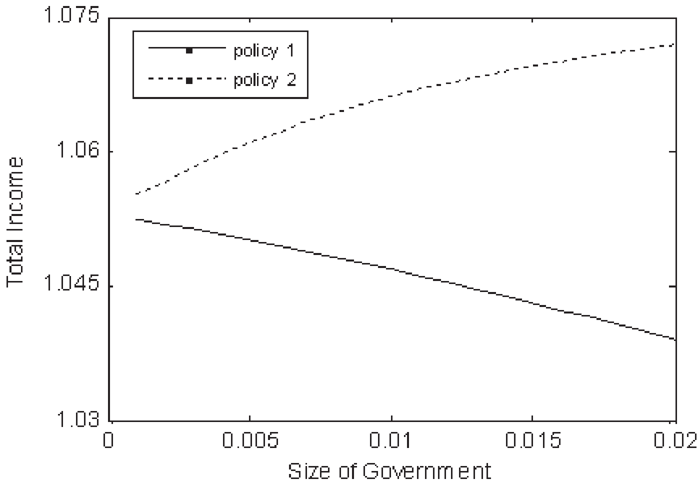

Figure 5: Total Income

further. Aggregate output is also reduced when overall industrialization (**H** and **M**) is pushed back, this effect is however small. The effects are shown in table 5, where the total negative effect should be compared to the reduction in aggregate output in table 4.

Firms	Effect on aggregate output
Exiting **M**	< -0.00001
From **M** to **H**	$+0.0027$
Old **H**, Subsidy	$+0.0048$
Old **H**, Downstream demand	-0.0013
Tax	-0.0200
Total effect	-0.0138

Table 5: Effects of Policy 1

There are two main mechanisms behind these results. First, part of the subsidy goes to firms with few backwards linkages, which are not able to generate much demand in the rest of the economy. Second, part of the subsidy promotes technology upgrading from **M** to **H**. This actually has adverse consequences for firms upstream, since the demand for their products decrease. Furthermore, profits in the firms that change to **H** do not rise sufficiently to compensate for the new fixed cost c that they now incur.

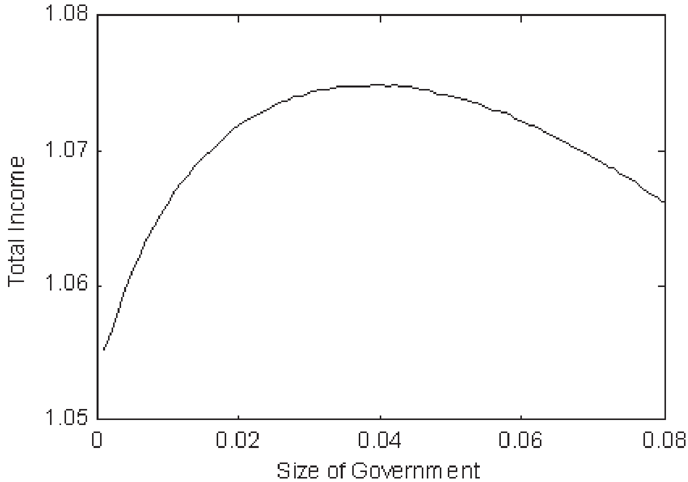

Figure 6: Total Income, Policy 2

In a setting with only the **A** and the **M** sector, the effect of policy 2 is strictly increasing in government size. However, things are different in a model with three sectors. Figure 6 plots the effect on total income of varying the government size from 0.001 to 0.08. This is obviously a concave function which reaches a maximum at a government size of about 0.04. Table 6 summarizes the effects of two government sizes, one close to and one above the optimal level.

The first column shows the index of the firm furthest downstream in each sector, and the second the change in profits in each sector, using no government as benchmark. The ratio presented in the third column gives a measure of how much profit is generated by each unit of subsidy spent. First of all, it is evident that profits in all sectors are increasing compared to the benchmark. Second, it is the firms furthest upstream that benefit the most. The is an artifact of the increase in demand for intermediate input as more firms downstream industrialize. From an aggregate perspective, subsidies are beneficial except in the sector which consists of new **M** firms. It is here that costs related to infrastructure is the highest, and it is consequently into

Firms	Gov=0.036 m	$\Delta\Pi$	$\frac{\Delta\Pi}{Subsidy}$	Gov=0.076 m	$\Delta\Pi$	$\frac{\Delta\Pi}{Subsidy}$
New **M**	0.599	0.014	0.51	0.783	0.029	0.44
Old **M**	0.292	0.008	1.87	0.292	0.002	1.84
From **M** to **H**	0.213	0.013	3.66	0.274	0.027	3.36
Old **H**	0.099	0.023	23.80	0.099	0.033	26.90
Tax		−0.036			−0.076	
Total Effect		0.022			0.016	

Table 6: Effects of Policy 2

these firms that the lion's share of the subsidies will be directed (76 and 86 percent respectively). These firms can only cover part of the cost due to infrastructure through own profits. As more and more **M** firms enter, a larger fraction of subsidies must be directed towards covering fixed costs. The increase in demand and profit upstream is eventually not sufficient to compensate for this cost. Moreover, reducing the fixed cost (while keeping the positions constant) actually decreases demand linkage effects. In addition to this, firms that shift from **M** to **H** will increase their profit, but at the same time generate less demand upstream. The mechanisms here are similar to policy 1.

6 Discussion

The model elaborated in previous chapters captures several of the mechanisms discussed in relation to India. The policy experiments can be thought of as directing government efforts either to facilitate overall industrial activities or to promoting the establishment of high-technology firms. This is another way of capturing the effect of increasing the quality of infrastructure (which is assumed to affect all industrial activities) or to increase the pool of skilled labor (which is assumed to be used in the high-technology sectors). The mechanism that drives our result is the linkage effect between firms. Due to the lower degree of backward linkages from the high-technology sector, a success here does not have the same positive effect as an equivalent expansion of the manufacturing sector. The results show that this mechanism generates substantial effects on aggregate income. Policy 1 can be said to resemble India's industrial policy the most, and the results from our model is consistent with recent experiences in India. A very profitable high technology service sector is thriving whereas basic manufacturing is lagging behind.

The most important issue integral to our model pertains to the interpretation of different sectors. The names we have attributed are somewhat misleading. To recapitulate we have first the **A** sector, which could be thought of as a composite of agriculture and basic services. Second, the **H** sector is a high-technology sector with many forward but fewer backward linkages, in contrast to the manufacturing **M** sector where backward linkages dominate.

There is no introduction of new goods in the model. In a static setting this should pose no problem, but when we perform the policy experiments we implicitly read in some quasi-dynamics. Specifically, we say that a firm transforms from **M** to being a **H** firm, or from being a **A** firm to becoming a **M** firm. How can this be interpreted? Compare the pre-industrial economy to one where the **A** sector make up one half and the other half is the **M** sector. From such a comparison we cannot say that the latter economy differs in the sense that new goods, e.g. automobiles, are available.

A more appropriate interpretation of the sectors is as different functions. The function of for instance transportation was available also in the pre-industrial stage albeit at a much less degree of efficiency than what was later possible with the introduction of automobiles. A similar argument can be made with regard to various sorts of food storage and preparation which as a consequence of industrialization becomes much more efficient. The same interpretation is possible when a firm transforms from **M** to **H**, thereby performing a specific function but now with, for instance, the aid of modern computers. We can also think of outsourcing and the process wherein firms specialize on core competencies as a prototypical case where a function is performed more efficiently. However, in our model it is not an increasing degree of specialization *per se* that causes increasing output, it is the opportunity to tailor a more efficient mode of production to specific functions.

Given the available empirical data, there are obvious problems with this interpretation. In principle this is however a way of identifying the sectors in our model.

7 Conclusions

The majority of the developed economies in the world have displayed a very distinct pattern of industrialization with regards to sectoral shares of aggregate production. Recent trends suggest that India is not following this typical pattern of industrialization. Evidence suggest that while certain high-technology industries are flourishing, growth in basic manufacturing is lagging behind. The contribution of this paper is first to describe these trends and to capture them in a theoretical framework where they are tied together.

Secondly, we extend a recent model in the big-push tradition by allowing for a partial industrialization equilibrium and choice of technology.

Under the assumption that a high-technology service sector buys intermediary inputs from its own sector only, it is shown that the design of industrial policy can have a substantial effect on aggregate income. When mainly directed towards the high-technology sector policy can actually cause a drop in aggregate income. A better way is to promote general industrialization by reducing the fixed costs of industrial production. However, as we have discussed the scope for such a policy is also limited.

The model and results presented captures the static effects of one plausible mechanism. With respect to the specific case of India, there are other equally important circumstances that can explain the lagging manufacturing sector. Exports and remaining institutional barriers are two of the most obvious alternative explanations. However, based on the findings in this study we maintain that it is important to acknowledge the risk of promoting a sector which is isolated, with respect to backward linkages, from the rest of the economy.

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Essay II

Compulsory Education and Jack-of-all-trades Entrepreneurs*

Robin Douhan
Research Institute of Industrial Economics (IFN)
and Uppsala University

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Abstract

Can educational institutions explain occupational choice between wage employment and entrepreneurship? This paper follows Lazear's (2005) Jack-of-all-trades hypothesis according to which an individual with a more balanced set of abilities is more likely to enter into entrepreneurship. In the theoretical model proposed, abilities are an outcome of talent and educational institutions. Institutions, in turn, differ with respect to mandatory time in school and the scope of the curriculum. Implications of the theory are tested using Swedish data for a school reform. Empirical results support the main theoretical predictions.

JEL: J24, I21, L26

Keywords: human capital, occupational choice, entrepreneurship, education institutions

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1 Introduction

Recent economic research has approached human capital as a multifaceted phenomenon. The importance of non-cognitive abilities has been emphasized in works by Heckman, Stixrud and Urzua (2006) and Borghans *et al.* (2008). Non-cognitive dimensions such as motivation, socioemotional regulation, time preferences and personality traits have a high predictive value for a range of labor market and behavioral outcomes. In view of these findings, Heckman (2008) makes a strong claim that the traditional bias toward cognitive skills in research and policy should be reduced. According to him, particular attention should be given to the multiplicity of human abilities.

Lazear (2004; 2005) showed that the multiplicity of human capital is also relevant for the study of self-employment and entrepreneurship.[1] He proposed the hypothesis that entrepreneurs are, in contrast to wage employees, generalists, or jacks-of-all-trades (henceforth, JAT). For the small scale entrepreneur internal division of labor is not a feasible option, and hiring competent outside specialists is often prohibitively costly. Hence, success depends on the entrepreneur's ability to undertake a wide range of different tasks in addition to his or her core competency, e.g., marketing, accounting, customer relations, *et cetera*. For larger scale entrepreneurs, both of these constraints are relaxed. However, Lazear still argues that high competence in a broad set of skills is important: the entrepreneur should be sufficiently "well-versed in a variety of fields to judge the quality of applicants" (Lazear 2005, p.650).[2]

In a formal analysis of the JAT theory, the entrepreneur is better able to gain from complementarities between different skills, but is also more vulnerable to any weak link in the chain of abilities required. Moreover, if wage work is

[1] Following prior literature we will talk about entrepreneurs rather than self-employed, although the latter are the ones we can identify in the data. The former is often taken to refer to a particular kind of person whereas the later denotes occupational status (Iversen *et al.* 2008).

[2] One could add a third argument that builds on the role of the entrepreneur as an innovator. Research on creativity and innovativeness has stressed the importance of combinations (e.g. Ward 2004). From this point of view, innovations are often a result of novel combinations of knowledge pertaining to different fields of expertise. This implies that the entrepreneur as an innovator must be highly skilled in a broad set of abilities. Whereas the discussion in Lazear (2005) pertains to the entrepreneur as an organizer, this argument suggests that the JAT-hypothesis is also valid when applied to the entrepreneur as an innovator.

perfectly specialized, the opportunity cost of entrepreneurship is closely related to the strongest ability. Taken together, these facts suggest that the probability of becoming an entrepreneur decreases with the variation across different skill levels in the (multidimensional) set of human capital. The JAT theory has previously been tested using generality of the entrepreneur's field of education (Lazear 2005), diversity in prior labor market experience (Wagner 2003; Astebro and Thompson 2007; Silva 2007) and variation in aptitude tests (Hartog, van der Sluis and van Praag 2008).

This paper expands the JAT literature in two directions. First, we use a large set of individual level data containing information about talents in early adolescence to test the basic JAT hypothesis. The results are indicative of the expected effect. More importantly, we proceed to test the interaction between educational institutions, talents in adolescence and occupational choice.

Education is modeled as a one-period event that individuals enter with a vector of talents and exit with a vector of abilities. Institutions that prescribe a longer time in compulsory education are shown to reduce entry into entrepreneurship for individuals who exhibit high variation in their set of talents. This is due to effects of so-called dynamic complementarity – a skill begets skill effect – which strengthens differences in skill levels and hence increases variation across skills.

We also show that probability of entry depends on the initial endowments of skills that are unaffected by education. The likelihood of entering into entrepreneurship is more positively affected by a longer time in school for individuals with a high talent for the relevant skills. These individuals gain the most from schooling by developing abilities that are complementary to their initial skills.

This implies that changing the scope of the curriculum by either excluding or including a particular skill will also affect entry decisions. In particular, if the curriculum is expanded by integrating more skills, this has the strongest negative effect on entry for individuals with high talents for abilities excluded in the old regime. These individuals lose the complementary effect of education in the new regime.

We test the propositions using a reform in compulsory education in Sweden dating back to the 1960s. At the time of the reform, two random samples, each consisting of about 10 percent of all individuals in a cohort, were surveyed, and data on their test results, interests and school performance together with background information were collected. Individuals from these two cohorts are matched to recent labor market data. The data allow for a difference-in-difference approach similar to Meghir and Palme (2005). In accordance with the theoretical predictions, the reform decreased entry into entrepreneurship for individuals with a high variation across skills. Moreover, the change to a more comprehensive curriculum reduced entry for those who scored high on an ability that was excluded in the old system.

The result that the returns on education for entrepreneurs depend on abilities unaffected by education (e.g., sociability, charisma) may be seen as a contribution to the literature on entrepreneurship and human capital (Iyigun and Owen 1998). It also relates to the issue of differential returns on education for entrepreneurs and wage workers (Van der Sluis, van Praag and Vijverberg 2008; 2005; Van Praag and van der Sluis 2007). This paper is also, to the best of our knowledge, the first to put the production function approach to education (suggested by, e.g., Cunha and Heckman 2007) into an occupational choice framework.

To put the issue discussed in this paper into a broader context, it is worth noting the importance for economic growth that is often attached to the entrepreneur (see, e.g., van Praag and Versloot 2007). A better understanding of the interaction between education and occupational choice therefore implicitly relates to the effect of education on growth.[3] Moreover, the analysis in this paper can shed some light on, and bind together, three trends that are pertinent in the twentieth century economic history. During this time, the scope and extent of compulsory education was heavily expanded in most developed countries. For instance, Boli, Ramirez and Meyer (1985) discuss the rise of mass education and the striking similarities of the newly built institutions. In tandem with this, the demise of entrepreneurship was predicted in an influential work by Joseph Schumpeter (1942). It has since been documented, notably by Loveman and Sengenberger (1991), that small scale businesses – often assumed to be the natural habitat for entrepreneurs – in fact

[3]Research on the relation between education and growth has been dominated by two theoretical approaches (see Krueger and Lindahl 2001). Following Nelson and Phelps (1966), research has stressed the role of education and human capital in adopting new technologies. Second, in endogenous growth theories accumulation of human capital sustains long run growth (Lucas 1988; Romer 1990).

decreased in importance in the post-war development of major economies. Big companies run on Fordist managerial principles with a high degree of specialization were seen as the main drivers of economic growth (Galbraith 1967). A third trend, which is consistent with the second, is the increased role of division of labor in economic development (Smith 1965 [reprinted]; Becker and Murphy 1992).

If increased schooling makes individuals more apt for specialized tasks, the three tendencies sketched above fit neatly together. One story that can be told is that educational institutions evolved to better fit the needs of a specialized workforce in big Fordist companies. The same institutions have endowed individuals with human capital less conducive to JAT entrepreneurship.

2 Theory

2.1 Human capital formation

Assume that human capital can be described as a vector of ability levels for n different types of abilities (or synonymously, skills), denoted θ. Each element $\theta_j \in \theta$ corresponds to a certain type of skill j.

Cunha and Heckman (2007) suggested that the skill level at time $t+1$ can be described in the following way:

$$\theta_{t+1} = f_t \left(h, \theta_t, I_t \right), \tag{1}$$

where h is parental characteristics and I_t investments at time t. Including present skill level θ_t allows for what they call self-productivity, i.e. a positive effect of past skills on future skills. We simplify the recursive structure and consider only two time periods. Let $\bar{\theta}$ denote the vector of abilities before education and θ after. We will refer to the former as talents and the latter as skills or abilities. The analysis is further simplified by abstracting from parental characteristics.[4]

Investments in eq (1) correspond to characteristics of the educational system in our setting. These are modeled using a vector S of length n where each element $s_j \geq 0$ corresponds to one ability $\theta_j \in \theta$. The interpretation of $s_j = 0$ is that the

[4] In the empirical part some controls for characteristics of the parents are included.

curriculum pays no attention at all to ability j. The higher s_j the more (quality adjusted) time is spent on ability j. A larger S will be somewhat loosely called a more extensive or longer education. We thus picture education in the following way:

$$\theta = f\left(\bar{\theta}, S\right). \tag{2}$$

Next, we impose some restrictions. A first assumption that is natural to make is that ability is increasing over the extent of education

$$\frac{\partial f\left(\bar{\theta}, S\right)}{\partial S} > 0. \tag{3}$$

Although education has a positive effect on the transformation from talent to (productive) abilities, it is plausible that some of the talent would be retained even outside of school. The second assumption is similar to what Cunha and Heckman (2007) call self-productivity. The higher the level of talent is for a specific ability, the higher the ability produced by the education technology will be:

$$\frac{\partial f\left(\bar{\theta}, S\right)}{\partial \bar{\theta}} > 0. \tag{4}$$

Now, we simplify the analysis considerably by assuming that education in a specific skill only affects this skill type. In other words, we preclude spillovers from education in one ability to other abilities. Similarly, we assume that self-productivity is only effective within a particular skill type. With a slight abuse of notation we may thus write

$$\theta_j = f\left(\bar{\theta}_j, s_j\right).$$

A final assumption is related to dynamic complementarity in Cunha and Heckman (2007). Dynamic complementarity means that investments in abilities are more productive when the prior talent is higher. This is captured by assuming that the cross derivative of eq (2) with respect to its two arguments is positive. For our purposes it is more helpful to first define the elasticity of education:

$$\sigma_j = \frac{\partial f\left(\bar{\theta}_j, s_j\right)}{\partial s_j} \frac{s_j}{f\left(\bar{\theta}_j, s_j\right)},$$

and then define dynamic complementarity as

$$\frac{\partial \sigma_j}{\partial \bar{\theta}_j} > 0. \tag{5}$$

In relation to compulsory education we also propose a slightly different interpretation. We will say that the system is more elitist the larger the value of (5). Such a system is focused on strengthening those who have a high talent level. A more egalitarian system would instead spend resources on supporting weak students.

2.2 Occupational choice

Lazear (2005) models a situation where an individual faces job market opportunities in the form of two different kinds of wage employment and self-employment. He considers a vector of abilities $\theta = \{\theta_A, \theta_B\}$. As an employee, the individual can specialize in one of the two abilities. Hence, the two are perfect substitutes, and the individual earns the higher of θ_A and θ_B. In entrepreneurship, the individual must rely on both abilities, which are perfect complements, and the profit is determined by the lower of the two. In making the occupational choice, he or she solves the problem:

$$\max\left\{\max\left(\theta_A, \theta_B\right), \lambda \min\left(\theta_A, \theta_B\right)\right\}.$$

Abilities are expressed in terms of their market value and should be interpreted as measures of productivity. For the setting to be interesting it must be assumed that $\lambda > 1$. In effect, this parameter embodies relative compensation levels, where wages have been normalized to 1. One intuition for $\lambda > 1$ is the possibility of earning higher returns from using one's abilities as complements in entrepreneurship.[5] For a distribution of ability vectors θ, we can write a binary condition for

[5]Lazear (2005), and Astebro and Thompson (2007) show that the parameter can be derived from a more fundamental production function where the entrepreneur employs the workers. λ will then summarize the relation between profit and wages. They do so assuming an exogenously given demand for entrepreneurs which is perfectly inelastic.

entry into entrepreneurship as:

$$\lambda \min(\theta) \geq \max(\theta), \tag{6}$$

where the vector of abilities is given by eq (2).

The analysis here will be restricted to just one vector, θ (generated by a draw of $\bar{\theta}$ from some arbitrary distribution). Stochastics is introduced in the model by letting λ_i be a draw from a probability distribution, $\lambda_i \sim G(\lambda)$. We have the property of probability distribution functions that $G' > 0$, and for simplicity we will assume that $G''(x) < 0$ for $x > 1$.[6] We can write the probability of becoming an entrepreneur for a given θ as:

$$P(entry) = 1 - G\left(\frac{\max(\theta)}{\min(\theta)}\right). \tag{7}$$

To facilitate the comparative statics exercise, it is assumed that elements in S take either some specific uniform value s or 0. In other words, all ability types that are part of the curriculum are treated similarly (at a given talent level). This assumption drastically simplifies the analysis by, among other things, implying that the order between different types of skills with $s_j = s$ is preserved. Comparative statics are conducted either by increasing s or shifting s_j for some ability type from 0 to s.

2.3 Comparative statics

To simplify the analysis we let $\bar{\theta}^+$ (θ^+) represent the most highly valued talent (ability) in the vector of talents and $\bar{\theta}^-$ (θ^-) the lowest. Moreover, assume that all talents are parts of the curriculum, i.e. that $s_j = s$ for all j. We then have:

$$P(entry) = 1 - G\left(\frac{\theta^+}{\theta^-}\right) = 1 - G\left(\frac{f(\bar{\theta}^+, s)}{f(\bar{\theta}^-, s)}\right). \tag{8}$$

[6] A specific case where this assumption holds is for $G = N(\mu, \sigma)$ with $\mu = 1$.

Differentiating with respect to s yields

$$\begin{aligned}\frac{\partial P}{\partial s} &= -G'\left[\frac{f_S(\bar{\theta}^+, s)}{\theta^-} - \frac{f_S(\bar{\theta}^-, s)\theta^+}{(\theta^-)^2}\right] \\ &= -G'\left[\frac{\theta^+}{\theta^-}\frac{1}{s}\left(f_S(\bar{\theta}^+, s)\frac{s}{\theta^+} - f_S(\bar{\theta}^-, s)\frac{s}{\theta^-}\right)\right] < 0\end{aligned}$$

where the inequality follows from the assumption in (5) and the properties of a probability distribution function. Although a more extensive system yields higher abilities for both high and low talent, the high talent ability is furthered the most. This is an effect of dynamic complementarity. Ability types that are already high when entering schooling are the ones that gain the most. Education thus has the effect of increasing the divergence among different skills and hence the variance in human capital. It is easily realized that this effect is stronger the larger the distance is between θ^- and θ^+; for individuals with a perfectly balanced set of talents, $\theta^- = \theta^+$, the effect on probability of entry is nil. Moreover, a more elitist system, i.e., institutions with a larger inequality in (5), also yields a stronger negative effect on entry.

Proposition 1 *Longer education reduces the probability of entry due to the effect of dynamic complementarity. The effect is increasing in the distance between the highest and the lowest valued talents (and zero if these are equal).*

Corollary 1 *The cross effect of longer education and variance of talents is stronger the more elitist the system is.*

Next, consider the case when $s_j = 0$ for one ability type (now letting $\bar{\theta}^+$ and $\bar{\theta}^-$ denote the highest and lowest abilities for which $s_j = s$). The level of talent for this type of ability is denoted $\bar{\theta}^0$, and the skill level is thus $\theta^0 = \alpha\bar{\theta}^0$. What is the effect of increasing s? The interesting cases are when $\theta^0 < f(\bar{\theta}^-, s)$ or $\theta^0 > f(\bar{\theta}^+, s)$. We then have

$$P(entry) = \begin{cases} 1 - G\left(\frac{f(\bar{\theta}^+, s)}{\theta^0}\right) & \text{if } \theta^0 < f(\bar{\theta}^-, s) \\ \\ 1 - G\left(\frac{\theta^0}{f(\bar{\theta}^-, s)}\right) & \text{if } \theta^0 > f(\bar{\theta}^+, s) \end{cases}$$

and consequently the following effects of an increase in s.

$$\frac{\partial P}{\partial s} = \begin{cases} -G'\left[\frac{f_S(\bar{\theta}^{+},s)}{\theta^0}\right] & < 0 \quad \text{if } \theta^0 < f(\bar{\theta}^{-},s) \\ -G'\left[-f_S(\bar{\theta}^{-},s)\frac{\theta^0}{(\theta^{-})^2}\right] & > 0 \quad \text{if } \theta^0 > f(\bar{\theta}^{+},s) \end{cases}. \tag{9}$$

For the intermediate case where $f(\bar{\theta}^{+},s) > \theta^0 > f(\bar{\theta}^{-},s)$ the probability in eq (8) is not affected by leaving one ability out of the curriculum. Also note that the probability function has kinks where the level of the ability left out equals the high or low ability. *Figure 1* demonstrates the effect for a continuum of values of s and $\theta^0 > f(\bar{\theta}^{+},0)$. For low $s < s^*$, return to employment and entrepreneurship is determined by θ^0 and θ^-, respectively. Return to employment is therefore constant up to s^*, whereas return to entrepreneurship is increasing. In the region $s^* < s < s^{**}$, proposition 1 holds, and probability of entry decreases. For $s > s^{**}$, the return to entrepreneurship is bounded by θ^0, whereas return to employment increases. The probability of becoming an entrepreneur consequently decreases.

The intuition for the result in (9) is that entrepreneurs gain from complementarity effects when the talent for the ability left out of the curriculum is high. For instance, an individual with high sociability may use this skill as an entrepreneur together with abilities acquired in school.

[Figure1: The effect of education when one ability is excluded from the curriculum]

From (9) we know that the effect of education will be altered if θ^0 either substitutes the highest or the lowest of the abilities that are developed in school. A high θ^0 will tend to substitute the highest talent developed in school, which implies that increasing s has a positive impact on entry into entrepreneurship. To complete the analysis, we must evaluate the effect of a higher θ^0 inside the regions in (9). Hence, we study the cross-derivative:

$$\frac{\partial^2 P}{\partial s \partial \theta^0} = \begin{cases} -G'' \left[\frac{f_S(\bar{\theta}^+,s)}{\theta^0}\right]^2 - G' \left[-\frac{f_S(\bar{\theta}^+,s)}{(\theta^0)^2}\right] & > 0 \quad \text{if } \theta^0 < f(\bar{\theta}^-, s) \\ -G'' \left[-f_S(\bar{\theta}^-, s)\frac{\theta^0}{(\theta^-)^2}\right]^2 - G' \left[-f_S(\bar{\theta}^-, s)\frac{1}{(\theta^-)^2}\right] & > 0 \quad \text{if } \theta^0 > f(\bar{\theta}^+, s) \end{cases} . \tag{10}$$

The positive signs follow from the assumption that $G''(x) < 0$ if the argument x is larger than 1. Since the argument is the maximum over the minimum value, this requirement holds. We summarize the results in the following proposition.

Proposition 2 *Longer education (weakly) increases the probability of entry more the higher the endowment value of an ability excluded from the curriculum.*

Now consider what happens when the ability j for which $s_j = 0$ is moved into the curriculum by setting $s_j = s$. An individual with a high value of $\bar{\theta}_j = \bar{\theta}^0$ was, by proposition 2, the one for whom longer education increased probability of entry the most. It is then intuitive that this individual will see the largest decline in probability of entry following an expansion of the curriculum. An exception is when θ^0 is very low so that $f(\bar{\theta}^0, s) < f(\bar{\theta}^-, s)$. In this case, entry will increase following a regime shift in which $\bar{\theta}^0$ becomes part of the curriculum.

Proposition 3 *A reform that incorporates a new skill type into the curriculum has more negative effects on the probability of entry the higher the level of the previously excluded ability (if the ability type excluded is not the lowest valued talent).*

Proof. See the Appendix. ■

Finally, we note that all effects discussed are cross-effects. We are not able to say anything about the direct effect of a reform (longer education or greater scope of curriculum) since these effects are in general dependent on the initial extent of education (s).

We now turn to the empirical part of this study. A reform in the compulsory schooling system is used to study the effects on entry into entrepreneurship later in life. Using this reform we are able to get results related to proposition 1 and 3.

3 Empirical evidence

3.1 The reform

A reform in the Swedish compulsory education dating back to the 1950s/60s was used to test the theoretical implications. Meghir and Palme (2005) study the effects of the same reform on final educational attainment and earnings; a detailed description of the reform can be found in Meghir and Palme (2003).

Before the reform, basic education in Sweden consisted of two parts: A basic compulsory school (*folkskola*) and a junior secondary school (*realskola*). Junior secondary school was a prerequisite for higher education, and selection into it was based on performance after the sixth year in school. Those who were not selected into junior secondary school continued for one or two more years (depending on municipality) in the basic compulsory school. Those who qualified for junior secondary school spent an additional three years in school before possibly moving on to higher tiers of education. After the reform, all students were educated for nine years in the same system.

The reform of compulsory education was the first step of a comprehensive reform that merged what had previously been three types of secondary schools. The political will was to break social injustices perceived to be created by early selection into tracks with academic or vocational biases (Erikson and Johnsson 1993). The new system was intended to break labor market segregation between academic and vocational occupations by raising the level of education in theoretical subjects among blue-collar workers (Heidenheimer 1978; Husén 1965).

Several changes were implemented in the curriculum concurrent with the reform. Embodied in the new curriculum was a new agenda with a broader and more encompassing notion of education (Dahllöf 1990; Richardson 2004). In particular, the new curriculum gave more room to aesthetics and practical subjects such as woodworking and home economics.

3.2 Presentation of the data

As part of a conscious strategy to calm political opposition, the reform was implemented so as to facilitate evaluation (Heidenheimer 1974). The new comprehensive system was introduced step-wise between 1949 and 1962, and two major evaluations were conducted in 1961 and 1966. On these occasions, samples consisting of about 10 percent of all students belonging to cohorts born in 1948 and 1953 were surveyed (at age 13). The data from these surveys contain detailed information on background variables, grades and test scores for about $20,000$ individuals.

From this survey data, we have information on intelligence test scores, school grades and questions related to the students' spare time activities. The intelligence test includes scores for three dimensions: ability to inductively continue numerical series (inductive ability), to identify the opposite of a given word (linguistic ability) and to recognize versions of figures folded in different ways (spatial ability). By using information about spare time activities, we can construct proxy variables for interest in three dimensions. The first is interest for social activities (sociability). The proxy used is the frequency of interaction with friends in spare time. Based on measures of the frequency of reading books and newspapers, we construct a variable for interest in general knowledge. The third proxy is interest for technical and mechanical activities (mechanical). Finally, we construct a variable for scholastic motivation that reflects grades obtained when controlling away the effect of intelligence.[7]

The available background data include information about the parents' level of educational attainment and their occupations. Using the latter, we constructed a dummy variable indicating whether or not the father was an entrepreneur. Importantly, we also have information about the municipality where an individual attended compulsory schooling.

The theory gives us little guidance as how to define the ability set. To alleviate some concerns about *ad hoc* definitions of ability sets, we will use two different sets of abilities throughout. The narrow set of abilities consists of the three IQ

[7] The model we estimate is: $Grade_i = \alpha + \beta \times IQ_i + \varepsilon_i$. Residuals ε are obtained as proxies for motivation. This is a stylized way of obtaining proxies for motivation where we abstract from the effects from parental influence, school characteristics and other non-cognitive skills. Moreover, the IQ measures are obtained as test scores which are also plausibly affected by motivation.

measures. In addition to these, the broad set includes measures of sociability, interest for general knowledge and scholastic motivation. The variables in each set are first re-scaled from 0 to 100. For each individual, the variance is then obtained as the variance across his values on the skills included in the set. The variable of mechanical interest is used separately in an attempt to capture one skill that was excluded from the curriculum prior to the reform but included in the post-reform system.

The survey data is combined with more recent register data for the years 2001–06. From register data we have access to information on annual wage income and income from self-employment and final educational attainment. Moreover, an indicator allows us to distinguish between unincorporated and incorporated self-employed individuals.[8] An individual is coded as one of the two types of entrepreneurs if she had this occupational status for at least three of the six years covered.

Summary statistics for all variables involved are reported in the Appendix, *Table A1.* In *Table 1*, we present some summary statistics divided into three groups: employees and unincorporated and incorporated entrepreneurs.

[Table 1. Summary statistics by occupational status]

Both types of entrepreneurs have lower final educational attainment levels than employees. This is consistent with lower scholastic motivation at adolescence and a lower interest in general knowledge. Those who became entrepreneurs, on the other hand, scored higher on the intelligence test administered at adolescence.

Whereas having a father who is an entrepreneur increases the likelihood of becoming an incorporated entrepreneur, it appears to have less effect on entry as an unincorporated entrepreneur. Moreover, incorporated entrepreneurs tend to have higher scores on the intelligence tests and score higher on sociability than

[8] The majority of unincorporated businesses are run as sole proprietorship. In contrast to an incorporated business these are not juridical subjects. An individual is categorized as (unincorporated) self-employed if more than half of his income pertains to income from self-employment. Income from self-employment is scaled by a factor 1.6 to allow for underreporting of earnings from self-employment mainly due to tax-evasion motives. On average about 75 percent of total income in the group of (unincorporated) self-employed is income from self-employment.

unincorporated ones. Finally, we note that incorporated as well as unincorporated entrepreneurs tend to have a lower variance than employees in both the narrow and the broad sets of abilities.

Unincorporated self-employed individuals comprise 4.6 percent of the sample and incorporated 4.1 percent.[9] Unincorporated businesses are, from an occupational choice-theory point of view, more problematic than incorporated firms. Most importantly, the latter requires an equity stake, whereas all it takes to start an unincorporated firm is registration at the tax authority. Starting an incorporated firm is therefore likely to be a more elaborate decision. Moreover, many firms are likely to change organizational form to becoming incorporated when they grow. To some extent, this implies that incorporated firms are more successful and therefore arguably run by entrepreneurs who made – from a theory point of view – a correct choice. These concerns, together with the differences shown in *Table 1*, suggest that it is useful to separate the two types in the empirical analysis.

3.3 Methodology and predictions

The sequential implementation of the reform allows for an evaluation that controls for cohort effects. The experiment was largely introduced on a municipality level (at that time, Sweden consisted of about 2,500 municipalities). Some municipalities were assigned to the experiment in 1966, when the second wave of the survey was conducted, but not at the time of the first wave, 1961. This feature of the reform allows for control of municipality-specific effects. The effect of the reform can be identified for individuals within a municipality where the reform status changed from 1961 to 1966. The methodology applied here follows Meghir and Palme (2005) closely: the basic regression model is:[10]

$$
\begin{aligned}
P(Ent_{idm}) \quad = \quad & \alpha_0 + \alpha_1 SchoolSystem_{idm} + \boldsymbol{\beta}_1 \mathbf{G}(Ability_{idm}) + \\
& \boldsymbol{\beta}_2 SchoolSystem_{idm} \times \mathbf{G}(Ability_{idm}) + \alpha_2 m_i + \alpha_3 d_i + \boldsymbol{\delta}\mathbf{X}_{idm} + \varepsilon_{idm}.
\end{aligned}
$$

[9] Individuals with no occupational status (i.e. neither self-employed nor wage employed) were dropped from the sample, in order to match the binary occupational choice modelled.

[10] More generally it is in the tradition of Angrist and Kreuger (1991), Harmon and Walker (1995), and Acemoglu and Angrist (2000).

Sub indices i, d and m indicate individual, cohort and municipality, respectively. Coefficients α_0 to α_3 are scalars and $\boldsymbol{\beta}_1$, $\boldsymbol{\beta}_2$ and $\boldsymbol{\delta}$ are vectors of coefficients. $\mathbf{G}(Ability)$ is a vector of functions that depend on different abilities, $SchoolSystem$ is a dummy that indicates whether the individual was assigned to the new comprehensive system, and X is a vector of controls. The outcome variable Ent is a dummy taking value 1 if the individual is an entrepreneur (of either type).

In this empirical design, the treatment group consists of individuals assigned to the new compulsory school system. Who, then, are the affected individuals within this group (Angrist 2004; Oreopoulos 2006)? As described, the new system had two main effects: prescribing longer compulsory time in school and changing the scope of the curriculum. Only individuals who would have quit after seven years (i.e., the ones ending up in the *folkskola*) were impacted by the first effect. The second effect impacted everyone assigned to the new system. Meghir and Palme (2003) report that around 60 percent of a cohort quit after seven (or eight) years before the reform (i.e., approximately 40 percent progressed to the *realskola*). This indicates that it is important to identify the individuals actually affected by spending a longer time in school.

We use two strategies to isolate the treatment effect. First, we note that the educational attainment of the father is a good predictor of which school (*folkskola* or *realskola*) the individual went into prior to the reform (Meghir and Palme 2005; 2003). Second, we follow Oreopoulos (2006) and look at final educational attainment. The argument is that individuals with higher attainment have higher scholastic aptitude and are therefore the most likely to have been assigned to the longer compulsory track (*realskola*) before the reform. To proxy the (counterfactual) assignment, we divide the sample using an indicator for high (above compulsory level) paternal education and high (above upper secondary high school) final educational attainment.[11]

We test propositions 1 and 3.[12] The prediction from proposition 1 is that indi-

[11] Since the average education level has increased, it is reasonable that the educational level that is required for an individual to count as highly educated is higher than for his father. Results are robust to other divisions.

[12] Due to the nature of the reform Proposition 2 is hard to test. Arguably the broader and more encompassing notion of education that was embodied in the new curriculum also had effects on the development of for instance social skills.

viduals with a high variation across talents decrease their probability of becoming entrepreneurs if assigned to the new school system. Proposition 3 predicts that individuals with a high talent for an ability excluded (here: interest for mechanical activities) decrease their probability of being self-employed the most when assigned to the new school system. We expect the first effect to pertain mainly to individuals who either have a low final educational attainment themselves or who have a father with low educational attainment.

3.4 Results

We first test the JAT proposition that low variance across abilities increases the probability of becoming an entrepreneur. *Table 2* shows the results for the variance across the narrow and broad sets of abilities. The first column reports estimates without any control for elements in the ability set. The effects are negative, and estimates are statistically significant at conventional levels, although weakly for the narrow set. An increase of one standard deviation in the variance in the broad (narrow) set implies a decreased probability of entry of 1 (0.4) percentage points. This corresponds to a 12 (5) percent decrease in entry probability.

To control for level effects, the second column for each set includes the sum of the elements in the set. The estimate for the narrow set drops below conventional significance levels, whereas the broad set remains highly significant. In the third column, we include controls for each element of the ability set. The broad index is still significant at the 10 percent level, and a one-unit change in standard deviation changes the probability of entry about 0.6 percentage points.[13]

We also note from *Table 2* that spatial intelligence is a good predictor of becoming an entrepreneur. The effect is strongly significant and a change of one standard deviation implies a change in probability of entry of 1 percentage point.

[Table 2. Testing the JAT-hypothesis on talents in adolescence]

[13] Note that by including the elements of the sets we are including variables that are collinear to the variance measures (which are by construction functions of the elements). This explains some of the reduction in significance levels.

Next, we add the new school system variable. We also include two interaction variables reflecting the interactions between the new school system and the variance across the set of skills and between the new school system and mechanical ability. *Table 3* reports results for the aggregate and for incorporated and unincorporated entrepreneurs separately. Estimates for the narrow and broad sets are reported in separate columns. Note first that the variance measure is not significant in any of the specifications, and neither is the main effect of the new school system.

The first panel reports estimates for the probability of becoming either an unincorporated or an incorporated entrepreneur. The cross effect between the new school system and the variance of the narrow set of abilities is negative and significant in all specifications. The coefficients for the cross effects between educational system and the broad set of abilities are negative but below significance levels when looking at the aggregate of the two types.

Turning to the second panel, we find negative and significant estimates for the cross effect of school system and variance. These results are robust to inclusion of the sum of components in the second column. For the narrow set, the estimates drop below statistical significance levels when including controls for each ability type separately in the third column.[14] The size of the average effects is similar for the narrow and broad sets. We can compare two individuals who only differ in their variance across abilities. One individual has a variance that is one standard deviation higher than the other. If both attended the new school system instead of the old, the one with the higher variation would experience a drop in probability of becoming an entrepreneur of 0.75 percentage points (18 percent) relative to the one with lower variation.

Finally, turning to the unincorporated entrepreneurs, we find little evidence of a cross effect between school system and variation. The estimated coefficients are even positive (but insignificant) for the broad set of abilities. However, the interaction effect between mechanical skills and school system is now negative, and

[14] When controlling for the elements of the sets separately or as a sum, the specification also includes an interaction term between these variables and the school system. This implies that we allow education to have an independent effect on each element (or the sum of them). Again, this means that we are including variables that are collinear to the ones of main interest, which explains part of the reduced significance.

the estimates are statistically significant. Again, compare two individuals with a difference in mechanical skills of one standard deviation. Relative to the one with lower ability, the other one experiences a reduction in probability of entry by 0.95 percentage points (21 percent) when the two attend the new school system instead of the old.

[Table 3. Interaction effect between talents and the school system.]

Next, we split the sample depending on the individuals' own and their fathers' final educational attainment. *Table 4* shows the results for the narrow and broad sets of abilities and the two types of entrepreneurs reported in separate panels.

The two first columns report results for incorporated entrepreneurs. The cross effects for variance and school system show the expected pattern both when the sample is split according to the father's education and the individual's own educational attainment. Those who have a father with low educational attainment or who themselves have themselves low educational attainment are the most likely to experience a large treatment effect from the reform. These are also the individuals for whom the cross-effect between variation and school system is negative and significant. The estimated effects are somewhat larger when the sample is split according to own educational attainment. The largest estimated effect is for the broad set of abilities and individuals with low educational attainment. Again, performing the thought experiment with two individuals distanced one standard deviation apart in variation across skills yields a reduction of 1.75 percentage points (40 percent) in probability of entry.

Turning to the unincorporated entrepreneurs in the two lower panels, we obtain a statistically significant negative cross effect between variation and school system in only one case. This is for the narrow set of abilities when the sample is split according to the father's education. However, when split in the same way, the estimated parameter is positive (but insignificant) for the broad set of abilities. With respect to the unincorporated entrepreneurs, we also see that the negative cross effect between mechanical ability and school system pertains to those who are most likely to be affected. We can also note that the same cross effect tends to be positive for incorporated entrepreneurs in the two upper panels.

[Table 4. Interaction effect between talents and the school system for different treatment groups.]

4 Discussion

This study has approached human capital as a multifaceted phenomenon. It has been argued that not only the level of abilities but also the variance across abilities matters. For an analysis of educational institutions this implies that it is not sufficient to take duration, even if it is quality adjusted, into account. Features such as the scope of curriculum and complementarities with non-cognitive skills must be a part of the analysis.

As highlighted by recent research, the occupational choice between entrepreneurship and employment is one issue where multiplicity of abilities matter. Lazear (2005) is the most recent proponent of the jack-of-all-trades approach to entrepreneurship. The entrepreneur is, in contrast to the employee, pictured as a generalist. As a generalist, the entrepreneur is able to draw on complementarities between skills, but at the same time is vulnerable to weaknesses in his or her set of abilities.

Using a reform in the compulsory education system, we have investigated the interaction between education and occupational choice. Variation across talents was found to significantly affect the probability of entering entrepreneurship. This is consistent with prior empirical work on the JAT hypothesis. When controlling for differences in education, the effects of variation in talents disappear. In a production function approach to human capital formation, this underscores the importance of acknowledging features of educational institutions.

Individuals with a high degree of variation across abilities were found to be less likely to enter (incorporated) entrepreneurship if they were assigned to the new school system. An interpretation suggested by the theory developed here is that the new, more extensive, school system was more efficient in transforming talents into abilities. Under the assumption of dynamic complementarities – i.e., that skill begets skill – this implies a more divergent set of abilities for higher initial variation across talents. This results in a lower probability of becoming a JAT entrepreneur. Empirically, the effect is stronger for those who had a father with low educational attainment or who themselves had low educational attainment. Individuals in this group had the highest probability of quitting school after seven years and hence are most likely to be affected by longer (nine years) compulsory education.

The empirical study also yielded results pertaining to interest in technical and mechanical work. The probability of becoming an entrepreneur is lower for an individual with a high score on interest for mechanical work if that individual attended the new comprehensive school. The new school system was built on a broader curriculum, where practical work (e.g., classes related to mechanical and technical skills) was included. The theory predicts that such reform should decrease entry the most for individuals who are highly talented in skills previously excluded. The intuition is that, prior to the reform, these individuals had the most to gain from complementarities between the skill excluded and the abilities learnt in school. Hence, the theoretical proposition is supported empirically.

A human capital vector of multiple dimensions increases the complexity of the analysis. A major concern is the overlap between different skills, and connected to this, the problem of defining abilities at the same level of abstraction. Theoretically, we simplified the analysis by assuming non-overlapping skills and abstracting from cross effects of developing one skill on other skills.

Empirically, we constructed two sets of talents, each of which arguably covers a broad set of abilities. To some extent this mitigates concerns that the JAT theory rests on the assumption that the same type of abilities is used in employment and entrepreneurship. Since technological as well as organizational constraints are likely to segment the labor market, this is arguably problematic. For instance, services that require practical skills may be more efficiently organized as small-scale businesses, whereas more analytical skills are better coordinated in large organizations.

The broad conclusion that emerges from this study is that educational institutions matter for occupational choice into wage employment or entrepreneurship. Moreover, the result strengthens the case for analyzing the occupational choice decision in a setting where human capital is formed by multiple abilities. In the context of entrepreneurship, this has some policy implications. By acknowledging the multiplicity of human capital, a narrow-minded educational policy could be a system in which attention is paid to each individual's most promising talents. One reason for such a recommendation is that in specialized employment, investment in a broad set of abilities implies a waste of resources. However, if entrepreneurs are jacks-of-all-trades, and if we believe that entrepreneurship (which one could define broadly as creative and innovative economic activities) is important, the policy prescriptions are different. An educational policy with the goal of promoting entrepreneurship would focus on developing skills which are complementary to the ability in which an individual is endowed with the highest talents.

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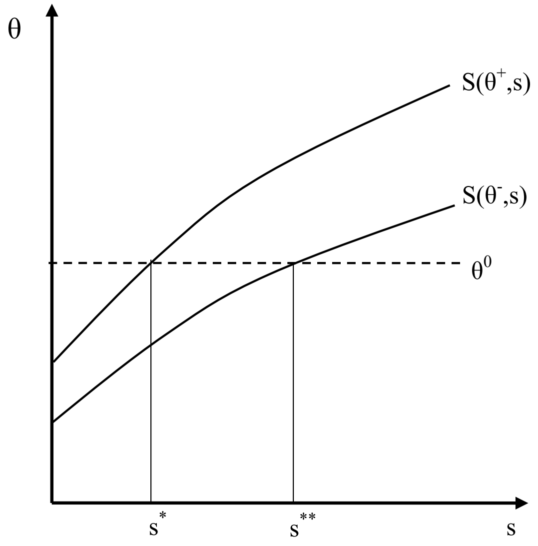

Figure 1. Effects increasing extent of school when one ability is excluded from curriculum.

Table 1
Summary statistics by occupational status

	Employees		Incorporated Entrepreneurs		Unincorporated Entrepreneurs	
Final educational attainment	2.81	1.55	2.53	1.51	2.37	1.50
High father education	0.17		0.19	-	0.17	-
Father entrepreneur	0.06		0.13	-	0.08	-
IQ inductive	49.80	20.09	52.23	18.81	50.43	19.36
IQ spatial	53.58	18.24	57.08	18.31	55.62	17.86
IQ linguistic	57.16	17.44	58.10	15.62	56.44	16.97
Scholastic motivation	46.26	10.68	44.66	10.59	44.94	10.92
Sociability	76.02	27.12	78.66	25.87	73.82	27.62
General knowledge	70.86	25.91	66.50	26.41	67.32	26.88
Mechanical skill	51.06	24.00	61.35	22.26	59.86	24.47
Variance (narrow ability set)	12.44	6.48	12.37	6.42	11.96	6.30
Variance (broad ability set)	22.33	6.14	21.67	5.80	21.63	6.12
Observations	18128		818		912	

Note: Final educational attainment takes values 1–6, where 1 is the lowest attainment (corresponding to the old *folkskola*) and 6 is the highest (PhD degree). Father's education is a dummy taking value 1 if the educational attainment of the father has education above compulsory schooling. Father entrepreneur is a dummy variable taking value 1 if the occupational status of the father (codes 14, 52 and 62–64). The narrow index consists of three IQ measures, and the broad index of the same three IQ measures, a measure of scholastic motivation, general knowledge and sociability.

Table 2
Testing the JAT-hypothesis on talents in adolescence

	Narrow ability set			Broad ability set		
Dependent variable: Entry into self-employment						
Variance	-0.064 (0.037)*	-0.059 (0.037)	-0.037 (0.041)	-0.170 (0.044)***	-0.174 (0.044)***	-0.094 (0.052)*
IQ inductive			0.012 (0.019)			0.028 (0.017)
IQ spatial			0.057 (0.020)***			0.053 (0.020)***
IQ linguistic			-0.031 (0.020)			-0.029 (0.021)
Scholastic motivation						0.003 (0.026)
Sociability						-0.013 (0.011)
General knowledge						-0.027 (0.011)**
Sum of components		0.013 (0.006)**			-0.004 (0.004)	
Observations	14610	14610	14610	13590	13590	13590

Note: Standard errors clustered on home municipality reported. Standard errors are reported in parentheses – *** indicates p-value <0.01, ** p-value<0.05, and * p-value<0.1. Coefficients and standard errors have been scaled by a factor 10^2.

All regressions include a constant term and controls for sex, cohort, mother's and father's education and a dummy taking value 1 if the father was an entrepreneur. The narrow index consists of three IQ measures, and the broad index of the same three IQ measures, a measure of scholastic motivation, general knowledge and sociability.

Table 3
Interaction effect between talents and the school system

	Narrow ability set			Broad ability set		
Dependent variable: Self-employment in incorporated and unincorporated firm						
School system	0.119 (0.614)	-2.236 (1.746)	-2.086 (1.942)	0.138 (0.589)	-4.223 (3.203)	-0.204 (3.978)
Variance	0.044 (0.061)	0.044 (0.061)	0.084 (0.065)	-0.107 (0.073)	-0.121 (0.074)	0.007 (0.090)
Mechanical skills	0.050 (0.022)**	0.049 (0.022)**	0.041 (0.022)*	0.055 (0.023)**	0.058 (0.023)**	0.059 (0.024)**
Variance x School system	-0.170 (0.079)**	-0.159 (0.079)**	-0.175 (0.085)**	-0.065 (0.085)	-0.053 (0.086)	-0.135 (0.103)
Mechanical skills x School system	-0.010 (0.022)	-0.012 (0.023)	-0.007 (0.023)	-0.013 (0.023)	-0.016 (0.023)	-0.025 (0.025)
Observations	14262	14262	14262	13274	13274	13274
Dependent variable: Self-employment in incorporated firm						
School system	0.744 (0.475)	-0.927 (1.300)	-0.255 (1.321)	0.541 (0.471)	-1.258 (2.324)	-0.805 (2.949)
Variance	0.065 (0.045)	0.066 (0.045)	0.076 (0.048)	-0.002 (0.045)	-0.003 (0.046)	0.033 (0.058)
Mechanical skills	0.006 (0.018)	0.004 (0.018)	0.001 (0.018)	0.015 (0.019)	0.013 (0.019)	0.011 (0.020)
Variance x School system	-0.128 (0.059)**	-0.119 (0.060)**	-0.104 (0.066)	-0.127 (0.059)**	-0.120 (0.060)**	-0.139 (0.076)*
Mechanical skills x School system	0.024 (0.019)	0.022 (0.019)	0.025 (0.019)	0.018 (0.019)	0.018 (0.019)	0.020 (0.020)
Observations	13481	13481	13481	12549	12549	12549
Dependent variable: Self-employment in un incorporated firm						
School system	-0.508 (0.450)	-1.716 (1.570)	-1.993 (1.717)	-0.541 (0.451)	-3.350 (2.677)	-0.360 (3.054)
Variance	-0.010 (0.050)	-0.012 (0.050)	0.022 (0.055)	-0.100 (0.059)	-0.117 (0.060)	-0.012 (0.074)
Mechanical skills	0.054 (0.018)***	0.056 (0.019)***	0.051 (0.019)***	0.053 (0.019)***	0.058 (0.020)***	0.062 (0.021)***
Variance x School system	-0.052 (0.060)	-0.049 (0.060)	-0.078 (0.064)	0.058 (0.068)	0.065 (0.069)	0.004 (0.084)
Mechanical skills x School system	-0.038 (0.017)**	-0.039 (0.017)**	-0.037 (0.017)**	-0.037 (0.018)**	-0.040 (0.018)**	-0.051 (0.019)***
Observations	13539	13539	13539	12593	12593	12593
Control for sum of component	No	Yes	No	No	Yes	No
Controls for components	No	No	Yes	No	No	Yes

Note: Regressions include controls for home municipality and the standard errors clustered on home municipality reported. Standard errors are reported in parentheses – *** indicates p-value <0.01, ** p-value<0.05, and * p-value<0.1. Coefficients and standard errors have been scaled by a factor 10^3.

All regressions include a constant term and controls for sex, cohort, mother's and father's education and a dummy taking value 1 if the father was an entrepreneur. The narrow index consists of three IQ measures, and the broad index of the same three IQ measures, a measure of scholastic motivation, general knowledge and sociability. When controlling for the sum of the index components or the individual components separately, an interaction term with the new school system is also included.

Table 4

Interaction effect between talents and the school system for different treatment groups

	Full sample	Low father education	High father education	Full sample	Low educational attainment	High educational attainment
Dependent variable: Self-employment in incorporated firm. Variance in narrow index						
School system	-0.273	-0.475	-0.391	-0.273	-0.714	-0.128
	(1.290)	(1.453)	(4.456)	(1.290)	(1.762)	(2.836)
Variance x school system	-0.105	-0.139	-0.043	-0.105	-0.154	-0.050
	(0.066)	(0.071)**	(0.153)	(0.066)	(0.085)*	(0.096)
Mechanical skills x school system	0.025	0.037	-0.040	0.025	0.036	-0.007
	(0.019)	(0.019)**	(0.045)	(0.019)	(0.021)*	(0.033)
Observations	13483	11037	2446	13483	8591	4892
Dependent variable: Self-employment in incorporated firm Variance in broad Index						
School system	-1.002	-1.010	-11.630	-1.002	-0.964	-6.843
	(2.915)	(3.315)	(8.415)	(2.916)	(3.983)	(5.663)
Variance x school system	-0.140	-0.176	-0.017	-0.140	-0.285	0.070
	(0.076)*	(0.088)**	(0.145)	(0.091)	(0.108)***	(0.091)
Mechanical skills x school system	0.020	0.025	-0.019	0.020	0.031	-0.006
	(0.020)	(0.021)	(0.050)	(0.020)	(0.024)	(0.031)
Observations	12551	10277	2274	12551	7989	4562
Dependent variable: Self-employment in unincorporated firm Variance in narrow index						
School system	-1.855	-1.515	-3.075	-1.855	-1.739	-2.354
	(1.651)	(1.623)	(5.940)	(1.651)	(2.159)	(2.573)
Variance x school system	-0.077	-0.132	0.119	-0.077	-0.102	0.081
	(0.064)	(0.071)*	(0.156)	(0.064)	(0.086)	(0.094)
Mechanical skills x school system	-0.036	-0.039	0.004	-0.037	-0.064	0.008
	(0.017)**	(0.019)**	(0.039)	(0.017)**	(0.023)***	(0.024)
Observations	13541	11100	2441	13541	8642	4899
Dependent variable: Self-employment in unincorporated firm Variance in broad Index						
School system	0.227	2.246	-9.568	0.237	1.551	-3.270
	(3.055)	(3.366)	(9.555)	(3.055)	(4.239)	(4.718)
Variance x school system	0.003	0.014	-0.055	0.003	-0.029	0.054
	(0.084)	(0.091)	(0.183)	(0.084)	(0.121)	(0.126)
Mechanical skills x school system	-0.050	-0.057	-0.010	-0.050	-0.086	0.020
	(0.019)***	(0.021)***	(0.045)	(0.019)***	(0.025)***	(0.027)
Observations	12595	10327	2268	12595	8029	4566

Note: Regressions include controls for home municipality and the standard errors clustered on home municipality reported. Standard errors are reported in parentheses – *** indicates p-value <0.01, ** p-value<0.05, and * p-value<0.1. Coefficients and standard errors have been scaled by a factor 10^3.

All regressions include a constant term and controls for sex, cohort, mother's and father's education and a dummy taking value 1 if the father was an entrepreneur. In addition to this, the regressions contain controls for the individual parts of the indices and interaction terms between these and the school system. The narrow index consists of three IQ measures, and the broad index of the same three IQ measures, a measure of scholastic motivation, general knowledge and sociability.

APPENDIX

Proof of proposition 3

We have six different cases for a given length of education s. We evalute the change in probability of entry ΔP (difference between after and before θ^0 is included in curriculum) due to the regime shift and the cross-effect with the value of θ^0 inside each region. The following properties and assumptions are used in each case

$$
\begin{aligned}
G(x_1) &> G(x_2) \text{ if } x_1 > x_2 \\
G'(x_1) &> G'(x_2) \text{ if } 1 < x_1 < x_2
\end{aligned}
$$

- Case 1: $f(\bar{\theta}^0, 0) > f(\bar{\theta}^+, s)$ $(> f(\bar{\theta}^+, 0))$ and $f(\bar{\theta}^0, s) > f(\bar{\theta}^+, s)$

$$
\begin{aligned}
\Delta P &= 1 - G\left(\frac{f(\bar{\theta}^0, s)}{f(\bar{\theta}^-, s)}\right) - \left(1 - G\left(\frac{f(\bar{\theta}^0, 0)}{f(\bar{\theta}^-, s)}\right)\right) < 0 \\
\frac{\partial \Delta P}{\partial \bar{\theta}^0} &= G'\left[\frac{f_\theta(\bar{\theta}^0, 0)}{f(\bar{\theta}^-, s)}\right] - G'\left[\frac{f_\theta(\bar{\theta}^0, s)}{f(\bar{\theta}^-, s)}\right] < 0
\end{aligned}
$$

- Case 2: $f(\bar{\theta}^0, 0) \le f(\bar{\theta}^+, s)$ and $f(\bar{\theta}^0, s) > f(\bar{\theta}^+, s)$

$$
\begin{aligned}
\Delta P &= 1 - G\left(\frac{f(\bar{\theta}^0, s)}{f(\bar{\theta}^-, s)}\right) - \left(1 - G\left(\frac{f(\bar{\theta}^+, 0)}{f(\bar{\theta}^-, s)}\right)\right) < 0 \\
\frac{\partial \Delta P}{\partial \bar{\theta}^0} &= -G'\left[\frac{f_\theta(\bar{\theta}^0, 0)}{f(\bar{\theta}^-, s)}\right] < 0
\end{aligned}
$$

- Case 3: $f(\bar{\theta}^0, 0) > f(\bar{\theta}^-, s)$ and $f(\bar{\theta}^0, s) < f(\bar{\theta}^+, s)$

$$
\begin{aligned}
\Delta P &= 1 - G\left(\frac{f(\bar{\theta}^+, s)}{f(\bar{\theta}^-, s)}\right) - \left(1 - G\left(\frac{f(\bar{\theta}^+, s)}{f(\bar{\theta}^-, s)}\right)\right) = 0 \\
\frac{\partial \Delta P}{\partial \bar{\theta}^0} &= 0
\end{aligned}
$$

- Case 4: $f(\bar{\theta}^0, 0) \le f(\bar{\theta}^-, s)$ and $f(\bar{\theta}^0, s) > f(\bar{\theta}^-, s)$

$$
\begin{aligned}
\Delta P &= 1 - G\left(\frac{f(\bar{\theta}^+, s)}{f(\bar{\theta}^-, s)}\right) - \left(1 - G\left(\frac{f(\bar{\theta}^+, s)}{f(\bar{\theta}^0, 0)}\right)\right) > 0 \\
\frac{\partial \Delta P}{\partial \bar{\theta}^0} &= G'\left[-f_\theta(\bar{\theta}^0, 0)\frac{f(\bar{\theta}^+, s)}{\left(f(\bar{\theta}^0, 0)\right)^2}\right] < 0
\end{aligned}
$$

- Case 5: $f(\bar{\theta}^0, 0) < f(\bar{\theta}^-, s)$ and $f(\bar{\theta}^0, s) < f(\bar{\theta}^-, s)$

$$\begin{aligned}
\Delta P &= 1 - G\left(\frac{f(\bar{\theta}^+, s)}{f(\bar{\theta}^0, s)}\right) - \left(1 - G\left(\frac{f(\bar{\theta}^+, s)}{f(\bar{\theta}^0, 0)}\right)\right) > 0 \\
\frac{\partial \Delta P}{\partial \bar{\theta}^0} &= G'\left[-f_\theta(\bar{\theta}^0, 0)\frac{f(\bar{\theta}^+, s)}{\left(f(\bar{\theta}^0, 0)\right)^2}\right] - G'\left[-f_\theta(\bar{\theta}^0, s)\frac{f(\bar{\theta}^+, s)}{\left(f(\bar{\theta}^0, s)\right)^2}\right] \\
&> G'\left[\frac{f(\bar{\theta}^+, s)}{\left(f(\bar{\theta}^0, 0)\right)^2}\right] - G'\left[\frac{f(\bar{\theta}^+, s)}{\left(f(\bar{\theta}^0, s)\right)^2}\right] \lesseqgtr 0
\end{aligned}$$

Table A1
Descriptive statistics

	Observations	Mean	Standard deviation
Entrepreneur	19858	0.087	-
Incorporated entrepreneur	19858	0.041	-
Unincorporated entrepreneur	19858	0.046	-
School system	21127	0.572	-
Sex	21127	0.491	-
Father high education	21127	0.174	-
Father entrepreneur	20139	0.072	-
High educational attainment	21127	0.353	-
IQ inductive	19306	56.37	
IQ spatial	19306	53.12	18.47
IQ linguistic	19285	48.73	20.23
Scholastic motivation	18061	45.70	10.74
Sociability	19143	76.01	27.35
General knowledge	19178	70.63	25.97
Mechanical skill	18773	0	23.97
Narrow index	19285	0	6.47
Broad index	17872	0	6.13

Note: Incorporated entrepreneurs are owners of an incorporated firm from which they earn wage income. Unincorporated entrepreneurs is sole proprietorship. An individual is coded as an unincorporated entrepreneur if 1.6 times income from self-employment is the largest source of income.

Father's education is a dummy taking value 1 if the educational attainment of the father has education above compulsory schooling. Father entrepreneur is a dummy variable taking value 1 if the occupational status of the father (codes 14, 52 and 62–64). Final educational attainment takes values 1–6, where 1 is the lowest attainment (corresponding to the old *folkskola*) and 6 is the highest (PhD degree). High educational attainment is a dummy taking value 1 if educational attainment is 4 or above corresponding to education above upper secondary high school).

The narrow index consists of three IQ measures, and the broad index of the same three IQ measures, a measure of scholastic motivation, general knowledge and sociability.

Data for income, occupational status and final educational attainment are register data from the so called LOUISE database. Data on school system, test scores and parental background are from the UGU dataset.

Essay III

Entrepreneurship, Wage Employment and Control in an Occupational Choice Framework*

Robin Douhan

Research Institute of Industrial Economics (IFN) and Uppsala University

Mirjam van Praag†

University of Amsterdam, Amsterdam Center for Entrepreneurship

Max Planck Institute of Economics, Tinbergen Institute and IZA

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Abstract

We combine two empirical observations in a general equilibrium occupational choice model. The first is that entrepreneurs have more control than employees over the employment of and accruals from assets, such as human capital. The second observation is that entrepreneurs enjoy higher returns to human capital than employees. We present an intuitive model showing that more control (observation 1) may be an explanation for higher returns (observation 2); its main outcome is that returns to ability are higher in higher control environments. This provides a theoretical underpinning for the control-based explanation for higher returns to human capital for entrepreneurs.

JEL codes: L26; I20; J24; J31

Keywords: Entrepreneurship; Ability; Occupational Choice; Human Capital; Wage Structure

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†Corresponding author. Email: C.M.vanPraag@uva.nl, phone: +31 20 525 4096.

1 Introduction

Entrepreneurs are more satisfied with their work than employees, even though they work longer hours and obtain lower and more variable rewards (Blanchflower and Oswald, 1998; Hamilton, 2000; Van Praag and Versloot, 2007). This remarkable difference is explained empirically by more autonomy and control over (the accruals from) one's own work as an entrepreneur compared to positions in wage employment (Benz and Frey, 2008). Control over one's work thus seems like an important distinguishing feature of entrepreneurship.

The aspect of control that we study in this article is control over the employment of and accruals from assets in the form of human capital. We do not consider the control-satisfaction relationship, but, instead, the relationship between control and the pecuniary returns to human capital. Empirical evidence indeed support the contention that entrepreneurs enjoy a higher return to their human capital (Van der Sluis *et al.*, 2005; Parker and Van Praag; 2006; Hartog *et al.*, 2008). Is more control over the employment of and accruals from human capital a likely explanation for this empirical observation?

The control explanation has a clear intuition. Entrepreneurs, defined as the business owning managers of their firms can better form and control the environment in which they operate than wage employees. They can adapt their production processes in a way that yields the highest return to their assets. One of these assets is their own human capital. Moreover, as a residual claimant of the firm, the benefits of the profitable use of their human capital accrue fully to the entrepreneur. Employees, on the other hand, are constrained by the organizational and wage structure surrounding them. Organizations cannot adapt their organizational and wage structure to every individual, i.e. both the jobs and the wages that individuals are matched to are not uniquely tailored. As a consequence, the proceeds from their human capital are not mapped on a one-to-one basis to the employees' earnings.

In this article we incorporate the notion of control in a general equilibrium occupational choice model. The main robust equilibrium property is that workers' returns to ability are higher when they work in an environment where they have more control. Therefore, our model provides a theoretical underpinning for the control-based explanation of the empirical observation that the returns to ability and education are higher for entrepreneurs than for employees. Moreover, some implications are derived in terms of the social allocation of human capital and the distribution of income in general equilibrium.

The notion of control is explicitly incorporated in the model as follows. Workers are employed by firms that utilize an exogenously determined number of wage brackets. Individual employees are assigned to particular functional levels based on their actual ability levels. Each functional level is attached to a wage bracket which is based on the average ability level of the workers in that functional level. Differential levels of control are modelled by varying the number of wage brackets. With just one wage bracket, an employee's remuneration level (and more implicitly, her tasks) does not depend on her ability and there is no control as how to employ or create value from human capital (ability in this case). When the number of brackets is increased, the sorting of employees over wage brackets is more accurately tied to their ability level. Hence, the correspondence between individual ability and remuneration increases in the number of brackets.

Another property of our model is that individuals with a high skill level as compared to their peers within their functional level are most likely to become entrepreneurs. In each bracket individuals are paid a wage corresponding to the mean skill level. Individuals with an ability level above the mean are consequently undercompensated. The opportunity cost of becoming an entrepreneur is hence determined in relation to the relevant wage bracket.[1] Thus, we will find entrepreneurs not only among the highest skilled, which would be the case with one wage bracket, but among those who are highly skilled relative to the mean ability within their bracket. This is consistent with the empirical observation that the division of the workforce over employees and entrepreneurs is not determined by ability levels (that are possibly generated by schooling).[2] Exactly this observation is what Lazear (2005) sought to explain with his jacks-of-all-trades hypothesis. Our model,

[1] In support of this, Andersson and Wadensjö (2006) establish evidence that people whose expected earnings – based on their observed characteristics including education and experience – in wage employment are higher than their actual earnings in wage employment are more inclined to become entrepreneurs.

[2] See for instance Van der Sluis *et al.* (2008), Hartog *et al.* (2008) and Van der Sluis *et al.* (2005).

which assumes that the entrepreneur can better command his abilities, yields the same prediction.

The main question that the model answers is how control, i.e., the number of wage brackets, affects the returns to ability. Given that more brackets increase the correspondence between ability and remuneration, the answer to this question might seem obvious. However, as *Figures 1a,b* in Section 3 will demonstrate, the relationship between control (as indicated by the number of wage brackets) and returns to ability may be positive, negative or zero.

General equilibrium occupational choice models in the tradition of Lucas, (1978) and Kanbur (1979) have implicitly assumed a higher degree of control for entrepreneurs than for employees by assuming a uniform wage level for employees and entrepreneurial profits dependent on the entrepreneur's ability. General equilibriums where the difference in control between entrepreneurs and employees is extremely high are hence well-explored; although the interpretation in terms of control has not yet been made. Much less is known about general equilibrium properties when the level of control varies. This article creates a better understanding of the general equilibrium effect of a differential level of control. Another contribution of this article is to show the possibility of finding an equilibrium in a general equilibrium setting which incorporates a control mechanism. The equilibrium is consistent with the robust empirical finding that ability plays an important role in shaping occupational choice decisions (between entrepreneurship and wage employment), in combination with higher returns to ability for entrepreneurs than for employees.

The remainder of the article is organized as follows. The next section provides an overview of the empirical results so far on the returns to human capital for entrepreneurs relative to employees. In Section 3 we discuss the model and in Section 4 its equilibrium properties. Section 5 concludes.

2 Returns to human capital for entrepreneurs versus employees

We shall now review the evidence with regard to returns to ability according to three indicators of ability: education, intelligence and balanced skills sets. Recent studies that measure the returns to education for entrepreneurs and compare them to those of employees – and acknowledges the endogenous nature of education to income – include Van Der Sluis *et al.* (2005) and Van Der Sluis and Van Praag (2007). The first study estimates income equations for a combined representative panel sample of entrepreneurs and employees from the U.S. population (NLSY). An instrumental variable approach is used to take into account that education is endogenous. Family background variables are used as instruments. Returns to education are found to be significantly higher for entrepreneurs than for employees. The result is robust to a specification with individual fixed effects and identification on switchers between employment and entrepreneurship.

Van der Sluis and van Praag (2007) use the variation over time and geographical regions (states) in compulsory schooling laws in the US as the identifying instrument for education, similar to Oreopoulos (2006). They extend the application by Oreopoulos by distinguishing entrepreneurs from employees. The dataset is taken from the US Census for each decade from 1950 until 2000. Again, the results show that the returns to education are substantially higher for entrepreneurs than for employees and that the result is robust to several possible measurement problems.

The two studies discussed pertain to the United States. Comparable studies for Europe have not yet been performed. However, Parker and Van Praag (2006) show, using a method similar to Van Der Sluis *et al.* (2005), but based on a Dutch sample of entrepreneurs only, that the return to education for entrepreneurs in the Netherlands is high, and, actually, higher than the returns to education for Dutch wage employees as measured using a similar method by Plug and Levin (1999). Moreover, a recent descriptive study of the education backgrounds of the 200 top entrepreneurs in the Netherlands shows that more than 60 percent of them have an academic background. This proportion is five times as high as it is for the general working population in the Netherlands in 2005 (CBS, 2007) and may therefore be indicative of substantial returns to education for entrepreneurs.

A second indicator of ability is intelligence. Hartog *et al.* (2008) is the only study to our knowledge which estimates income equations for entrepreneurs and employees in order to quantify the returns to (various kinds of) intelligence and ability for entrepreneurs relative to employees. Based on a representative panel of individuals in the United States (NLSY), Hartog *et al.* (2008) find that the returns to general intelligence (using the ASVAB [Armed Service Vocational Aptitude Battery] scores measured at a young age) are higher for entrepreneurs than for employees. The returns to general ability are estimated to be higher for entrepreneurs than for employees in both random-effects and fixed-effects frameworks, where the latter controls for unobserved time-invariant individual characteristics. This suggests that it is really occupational returns rather than personal characteristics which underpin the findings.

The third measure of ability that has been studied in the literature is the balance between various dimensions of abilities. A recent series of articles, initiated by Lazear (2005) and further built on by Wagner (2003), Silva (2007) and Hartog *et al.* (2008) pays attention to the combination of different competencies instead of merely their level. People with balanced scores on various measures of skill are so-called Jacks-of-all-Trades (JAT) (Lazear, 2005). These studies find unambiguous evidence for higher marginal returns to a balanced set of skills for entrepreneurs than for employees.

Another relevant finding in Van der Sluis *et al.* (2005) is that people who have a high perceived control over the environment, measured by locus of control (Rotter, 1966), also have higher return to education. If locus of control is used as a proxy for actual control, those entrepreneurs and employees who have the perception that they are in control of their environment should experience, on average, higher returns to education .[3] Besides the control explanation, two alternative theoretical mechanisms that are consistent with this empirical evidence can be identified.[4] First, higher educated individuals have better outside opportunities. Hence, they

[3] Individuals with an external locus-of-control personality tend to perceive an event as beyond their control, and attribute the outcomes of the event to chance, luck, as under control of powerful others, or as unpredictable.

[4] Various alternative explanations related to measurement issues have been put forth, tested and rejected by Van Der Sluis *et al.* (2005).

are likely to venture into projects with a higher expected return. If such projects are at the same time more risky they may require an additional profit margin as a risk premium, which could cause the observed effect of differential returns to education. Van Der Sluis *et al.* (2005) test and reject this hypothesis. Their findings indicate that entrepreneurs are indeed exposed to more income risk than employees, but that the difference is a decreasing rather than an increasing function of education. Thus, they conclude that the higher returns to education or ability for entrepreneurs are not a kind of risk premium.

The second explanation is related to signalling theory. The classic notion has long been that education can only be used as a signal of superior productivity by employees, not by entrepreneurs, as the only stakeholders towards whom signals can be valuable are (prospective) employers (Weiss, 1995). However, as recent works indicate and support empirically, entrepreneurs may use their education as a signal towards suppliers of capital (Parker and Van Praag, 2006), or towards customers and highly qualified employees (Backes-Gellner and Werner, 2007). This may provide an explanation for higher returns to education for entrepreneurs than for employees, but not why the return to cognitive abilities as such is higher.

3 The Model

Preliminaries

We consider a standard occupational choice model. Individuals who are only heterogeneous with respect to general ability make a choice whether to become an entrepreneur or a wage employee.[5] An individual's ability level affects the relative return to entrepreneurship and employment, and thereby determines the entry decision. Human capital, i.e., general ability enters into the entrepreneur's production function as the only input.

The model is amended in a simple way by assuming that firms use multiple discrete wage levels. The common assumption in this class of models has been

[5] This is in contrast to Lucas (1978) and Kanbur (1979) who both assumed that agents were heterogeneous in managerial ability – used as an entrepreneur – but homogeneous in abilities relevant for wage employment.

that either there is only one wage level (e.g. Kanbur (1979) and Lucas (1978)) or individual wages are a continuous function of individual characteristics such as ability, experience and education, as in the classic Mincerian approach (1974). Both of these assumptions are arguably at odds with reality. There are numerous circumstances that prevent the employer from perfectly tailor jobs to each individual's unique characteristics. At the firm level, such tailor made procedures would arguably be prohibitively costly and also clash with other organizational goals. Other obstacles pertain to labor market rigidities such as collective wage bargaining and employment protection which increases the cost of flexibility in job assignment.

By imposing discrete wage levels we position ourselves somewhere in between these two extremes and add to the realism of the model. The implicit assumption is that employers are unable to perfectly discriminate between the ability levels of wage workers. Moreover we assume a situation where all brackets are of equal size. The distribution of ability used is generated from an underlying distribution of talent and a production function. This allows us to make some interpretations in terms of educational institutions represented as features of the production function.

We use the model developed below along these lines to analyze the control theory by answering the question how the number of wage brackets, i.e., control, affects the return to ability for employees (vis-à-vis entrepreneurs).

It should be emphasized that in our model the indicator for control is the strength of the association between input (in our case ability) and the employee's proceeds from output (i.e., in terms of wages in our case). Alternatively, one could think of how control affects the firm's output. Our model does not address this question. Neither do we address control in terms of the employee's freedom to allocate effort and ability over various tasks. The decision in our model is a binary occupational choice between employment and entrepreneurship. This choice thus assigns individuals to a particular degree of control in terms of association between ability and proceeds – not in terms of freedom to allocate time.

The equilibrium wage rate in each bracket is determined based on the mean productivity within this bracket. This implies that an individual within the bracket may be under- or overcompensated depending on whether his ability is below or above the mean. This is the essence of the lack of control of return to ability, and hence to education, as a wage worker. Control increases in the number of brackets, but for any finite number of brackets it will always be lower than for the entrepreneur who is assumed to get a one-to-one return on his human capital. Therefore, the entrepreneur will by construction always have a higher return to education than the employee. Our primary interest is to investigate the effect of increasing the number of brackets, implying an increase in the control of wage employees, on the returns to ability for employees. If more control leads to higher returns in wage employment we can induce that the control-explanation may be a valid explanation for the higher returns to ability in entrepreneurship vis-à-vis wage employment.

Figure 1a shows intuitively what happens when one wage bracket (L) is subdivided into two at the point A. The wage will tend increase for those with ability above A and decrease for those below. It follows that the correspondence between ability and compensation increases. However, in a general equilibrium framework there are counteracting mechanisms. A stronger correlation between ability and wage tends to increase profits, shifting the profit curve upwards, see *Figure 1b.* This increases the number of entrepreneurs in M and H, thereby increasing labor demand. The net effect on the wage in the lowest of the subdivided brackets is inconclusive.

——————[FIGURE 1a & 1b]——————-

Production

Individuals can choose to become either entrepreneurs or workers. Entrepreneurs hire workers, and their own contribution is purely managerial, i.e. entrepreneurs do not enter as labor input. Wages and profits are expressed in relation to the price of the good produced, which is normalized to 1.

Although entrepreneurs are perfectly informed about workers' ability, they have a limited capability of discriminating them into different wage brackets. More specifically, they are able to sort workers into n distinct ability brackets, where n is exogenously given. It is worth emphasizing that n is no choice variable. Hence, it would not add anything to the analysis to assign a cost dependent on n (which might seem natural). Moreover, n is a unique number, i.e., all firms in the economy employ exactly the same number of wage brackets in their firms.

Throughout, we use j to denote brackets and the set of brackets is $B = \{j\}_{j=1}^{n}$. For simplicity, we assume that these brackets all contain the same number of individuals, i.e., $1/n$ of a total population of N belongs to each bracket j.[6] Each individual i is endowed with an ability θ_i which is drawn from a distribution $H(\theta)$. Depending on the distribution $H(\theta)$, $n-1$ ability levels will constitute breakpoints between different brackets. We assume that $H(\theta)$ is continuous, strictly increasing and everywhere differentiable. The wage is uniform within each bracket and is in equilibrium determined by the average productivity within the bracket. Hence wages do not perfectly reflect the ability of each individual worker.

Entrepreneurs, on the other hand, earn a profit that reflects their actual ability. We assume that the contribution of labor from each bracket is scaled by the average productivity in that bracket. Hence, implicitly we are abstracting from individuals' work-effort decisions and the possibility of shirking. Workers within a firm are assigned to one out of n different wage brackets. Each task is subject to decreasing returns to scale, determined by a parameter $\gamma \in [0.5, 1)$. Without a scale effect, all workers would be hired by the entrepreneur with the highest ability.[7] These assumptions yield the following production function:

$$f(\theta_i, \{L_k\}_{k=1}^{n}, \{\bar{\theta}_k\}_{k=1}^{n}) = \theta_i^{\alpha} \left[\sum_{k=1}^{n} \left(\bar{\theta}_k L_k \right)^{\gamma} \right]. \tag{1}$$

Labor input from each bracket k is denoted by L_k. Note that given (1), we will find entrepreneurs among the high ability individuals within each bracket. These are the individuals who lose the most by becoming an employee and conforming to the wage rate in their bracket, and these are also the ones with the highest profit as entrepreneurs. Finally, we add a parameter $\alpha \in (0, 1)$ which shifts the role of

[6] We assume $n < N$. As n grows large, the level of control in employment approaches the level of control in entrepreneurship and our model breaks down.

[7] An alternative to the production function here is one where the total amount of labor employed is subject to decreasing returns to scale (rather than labor in each bracket). The disadvantage of such a functional form is that the general equilibrium properties are much less stable.

the entrepreneur's own ability.[8]

Firm's decision and labor demand

The entrepreneur *qua* firm makes a decision on how much labor to hire from each wage bracket. The price of the good produced is normalized to 1, and the entrepreneur's earnings can therefore by described as in equation (1). Moreover, the firm pays w_k for each unit of labor hired from bracket k. Put together, each entrepreneur i solves the following standard maximization problem,

$$\max_{\{L_k\}_{k=1}^{n}} \theta_i^{\alpha} \left[\sum_{k=1}^{n} \left(\bar{\theta}_k L_k \right)^{\gamma} \right] - \sum_{h=1}^{n} w_k L_k. \tag{2}$$

Note that because $\gamma < 1$, all entrepreneurs will hire a mix of labor from all brackets in order to minimize negative scale effects. Solving the maximization problem yields n first order conditions, one for each bracket k:

$$L_{ik} = \left(\bar{\theta}_k \right)^{\gamma/(1-\gamma)} \left(w_k \right)^{1/(\gamma-1)} \left(\gamma \theta_i^{\alpha} \right)^{1/(1-\gamma)}, \forall k \in B. \tag{3}$$

The higher an entrepreneur's ability level, the more workers they will hire. Because $\frac{1}{1-\gamma} > 1$, the number of workers hired is a convex function of the entrepreneur's ability level. Furthermore, the ratio of entrepreneur i's labor demand from bracket k and h is as follows:

$$\frac{L_{ik}}{L_{ih}} = \left(\frac{\bar{\theta}_k}{\bar{\theta}_h} \right)^{\gamma/(1-\gamma)} \left(\frac{w_h}{w_k} \right)^{1/(1-\gamma)}. \tag{4}$$

This ratio tells us how the hiring decision from different wage brackets is determined by the trade-off between the benefits of higher ability levels and the costs of higher wage levels in increasing wage brackets. To see how this depends on γ, assume that h represents the higher wage bracket and k the lower wage bracket, such that $\frac{\bar{\theta}_k}{\bar{\theta}_h} < 1$ and $\frac{w_h}{w_k} > 1$. As long as $\gamma > 0.5$ we have $1 < \frac{\gamma}{1-\gamma} < \frac{1}{1-\gamma}$. The higher is γ, the more important will the ratio of productivity relative to wages be

[8] α is only included for the technical purpose of facilitating the numerical solution, and plays no role for the results.

in determining labor demand. This will tend to channel demand toward the high end of the ability distribution, i.e., where ability and wages are high. Conversely, if γ decreases, demand will grow stronger in the lower end of the distribution where ability, but also wages, are lower. As we will see, through this mechanism, the level of γ will have important consequences for the wage spread between different wage bracket and thus for returns to ability in wage employment. We will refer to the deviation from the situation that would result from $\gamma = 1$ as a "demand shift" effect of γ, shifting demand towards the lower end of the ability distribution.

Substituting the n conditions in equation (3) back into equation (2) and collecting terms yields the indirect profit function,

$$\pi_i = \theta_i^{\frac{\alpha}{1-\gamma}} \left[\sum_{k=1}^{n} \left(\frac{\bar{\theta}_k}{w_k} \right)^{\frac{\gamma}{1-\gamma}} \left(\gamma^{\frac{\gamma}{1-\gamma}} - \gamma^{\frac{1}{1-\gamma}} \right) \right]. \tag{5}$$

In circumstances where the discussion does not involve $\bar{\theta}_k$ and w_k we will let $\pi(\theta_i)$ denote the profit of individual i. The first term inside the square bracket captures the importance of productivity relative to wages, already discussed in relation to equation (4). The second term inside the square bracket increases in γ and captures the fact that as γ grows, entrepreneurial earnings from each unit of labor increase. The entrepreneur's own ability enters multiplicatively to this sum, which implies that the ratio of profit for two individuals $i \neq j$ is:

$$\frac{\pi(\theta_i)}{\pi(\theta_j)} = \left(\frac{\theta_i}{\theta_j} \right)^{\frac{1}{1-\gamma}}. \tag{6}$$

This ratio shows the role of the parameter γ in determining the impact of the entrepreneur's own ability in profits. Assuming that $\theta_i > \theta_j$ individual i will have a higher profit as an entrepreneur relative to individual j the higher is γ. Prospective profit as an entrepreneur in effect determines the opportunity cost of wage employment. Hence, the higher is γ, the higher is the wage of high ability individuals. We will refer to this as a "supply shift" effect of γ, where the effect refers again to the deviation from a situation with parameter value $\gamma = 1$. An equilibrium in this model involves a set of n ability levels that divide each bracket into workers and entrepreneurs, and a set of n wage levels.

Equilibrium I - Occupational choice

Individuals make an occupational choice between wage employment and entrepreneurship. As a wage employee the individual is assigned to a wage bracket depending on her ability level. Naturally, individuals become entrepreneurs whenever the resulting profit is higher than the wage they can earn as an employee.[9] Within each ability bracket, individuals with the highest ability levels become entrepreneurs. Thus in general, entrepreneurs may have higher or lower ability levels than wage workers.

Following standard procedure we identify a marginal individual for whom profit equals wage. In our setting we must perforce do that for each of the n brackets. The ability of this marginal worker/entrepreneur in bracket j will be denoted by θ_*^j. Individuals from the same bracket with lower ability levels will become workers and those with higher ability levels entrepreneurs. To keep track of the ability levels that divide the workforce into wage brackets, let θ_H^j be the highest and θ_L^j the lowest ability level in bracket j. Note that $\theta_H^j = \theta_L^{j+1}$, $\theta_H^n = \theta_H$ and $\theta_L^1 = \theta_L$. Also note that $\theta_L^j \leq \theta_*^j \leq \theta_H^j$, where an equality in the first case means that effectively everyone who would be attributed to wage bracket j as an employee will become an entrepreneur, and an equality in the latter case that no one within this bracket will opt for entrepreneurship. The average productivity in bracket j follows as:

$$\bar{\theta}_j = \frac{\int_{\theta_L^j}^{\theta_*^j} \theta_i dH(\theta)}{\left(H(\theta_*^j) - H(\theta_L^j)\right)}, \forall j \in B. \tag{7}$$

If a bracket contains both entrepreneurs and wage workers, we can use the equality between equation (5) and wage to identify the ability of the marginal worker/entrepreneur θ_*^j. However, some brackets may contain only workers ($\theta_*^j = \theta_H^j$) and some only entrepreneurs ($\theta_*^j = \theta_L^j$).[10] To sum up, we have:

[9] This implies that individuals are assumed to be risk neutral and that their utility is driven by financial rewards only.

[10] In practice, it will never happen that a bracket contains only entrepreneurs, since in that case, the wage would be pushed up to extreme levels due to a lack of supply.

$$\begin{cases} (i) & \theta_*^j = \pi^{-1}(w_j) & \text{if } \pi(\theta_L^j) < w_j < \pi(\theta_H^j) \\ \\ (ii) & \theta_*^j = \theta_L^j & \text{if } \pi(\theta_L^j) \geq w_j \\ \\ (iii) & \theta_*^j = \theta_H^j & \text{if } \pi(\theta_H^j) \leq w_j \end{cases} \tag{8}$$

for all $j \in B$. Substituting equation (7) in (5) and applying the conditions in equation (8) will identify n equilibrium cut off points $\left\{\theta_*^j\right\}_{j=1}^n$ that divide the $1/n$ individuals per wage bracket into groups of wage earners and entrepreneurs. Note that even if wages are exogenous, this is a problem that involves a system of n non-linear equations which is intractable to an analytical solution.[11]

Equilibrium II - Labor market

The division into wage brackets means that we will in effect have n labor markets. Labor supply in market j is defined as the number of individuals in this bracket net of entrepreneurs. Formally, we write labor supply as

$$L_j^S = \frac{N}{n} - N\left[H(\theta_H^j) - H(\theta_*^j)\right]. \tag{9}$$

Labor demand from bracket j may come from all n brackets which makes this part a bit more involved. Using equation (3) we can write demand for bracket j workers from bracket k entrepreneurs as the following integral

$$L_{kj}^D = N \int_{\theta_*^k}^{\theta_H^k} L_{kj}(\theta_k, w_j) dH(\theta).$$

The sum over entrepreneurs from all k brackets defines the total demand from bracket j:

$$L_j^D = \sum_{k=1}^n L_{kj}^D.$$

Given this we can determine the n wages that clear the market in each bracket.[12]

[11] This would still hold with another assumption about the distribution of talents (e.g. a uniform distribution instead of the normal distribution used).

[12] Since there exists no way to determine the market clearing wage in the hypothetical case that all individuals belonging to a certain bracket become entrepreneurs, we will simply assume that

If $\theta_*^j = \theta_L^j$ we set $w_j = \pi(\theta_L^j)$, and otherwise we set w_j to be the wage that solves

$$L_j^S = L_j^D, \tag{10}$$

for all $j \in B$. This gives us n conditions to identify the set of equilibrium wages $\{w_j\}_{j=1}^n$. Altogether we have a system of $2n$ equations where the $2n$ unknowns enter each equation. This system is solved numerically. We refer to Appendix A for a description of the iterative procedure used to solve the model.

4 Equilibrium properties

The ability distribution

The distribution we analyze is generated from a normal distribution. Individuals are assigned a potential ability level $\hat{\theta}_i$ drawn from a distribution $N(\mu, \sigma)$. The actual ability level is then determined by the following equation:

$$\theta_i = \hat{\theta}_i \left(1 - \exp(-t + \lambda t \left(\hat{\theta}_i - \kappa\mu\right))\right). \tag{11}$$

This simple transformation allows for an intuitive interpretation in terms of educational institutions. We can think of t as the (quality adjusted) time in school. The parameter $\lambda \in \{-1, 0, 1\}$ can be interpreted as the degree of elitism in the system. $\lambda = -1$, implies that individuals who have a high potential ($\hat{\theta}_i$) benefit more from education. If $\lambda = 0$ the system will be called neutral and with $\lambda = 1$ egalitarian (implying that low potential individuals gain the most from education). An egalitarian system skews the distribution to the left whereas the elitist system skews it to the right. The parameter κ is used to scale the distribution so that average productivity is constant irrespective of the value of λ.

Throughout we use a normal distribution of potential talents where $\mu = 1.25$ and $\sigma = 0.5$, together with $t = 2$ and $\lambda = 0$ in equation (11) if nothing else is indicated. Moments for the transformed distribution are indicated with the results. Moreover, we bound the range of potential abilities to $\hat{\theta}_i \in [0.5, 2]$, and

the wage in the bracket equals the profit of the lowest ability entrepreneur within the bracket.

choose $\gamma = 0.75$ and $\alpha = 0.75$ as the benchmark case.[13] The population size N is normalized to 1.

Results

Table 1 shows the effect of increasing the number of wage bracket on some equilibrium properties for $\gamma = 0.75$ and $\gamma = 0.9$. Both entrepreneurial and wage income tends to increase. As the number of brackets increases, each bracket will contain less workers and thus be affected less by decreasing returns to scale. Comparing $\gamma = 0.75$ with $\gamma = 0.9$ we see that the increase in income is less for the higher parameter value where decreasing returns are less pronounced.

——-[TABLE 1]———

Another main feature is that the share of entrepreneurs decreases as the number of brackets increases. This is due to several effects. First, on average, the ability of highly skilled wage employees will be less undervalued, and the average wage level increases. This will have the effect of increasing the opportunity cost of entrepreneurship. At the same time, the entrepreneurial profits increases due to more efficient use of labor as ability and wages become more aligned. As *Table 1* reveals, the first two effects dominates the latter, resulting in a net outflow of entrepreneurs. Moreover, we note from *Table 1* that a larger number of brackets increases the general equilibrium income inequalities between wage workers and entrepreneurs. Entrepreneurs have a higher income in part because they have a higher average ability level, so that even as workers they would have a higher average income (i.e. a selection effect), and in part by virtue of being entrepreneur.

The increased average wage level is the net effect of three drivers. The first is a demand effect; more brackets reduce the negative effect from diminishing returns, allowing entrepreneurs to increase their labor demand. Counteracting this effect is the above mentioned tendency of a declining share of entrepreneurs. A third

[13] The parameter α is added for technical purposes. By setting $\alpha < 1$, we will get an equilibrium with more entrepreneurs which has more stable properties for the purposes of a numberical solution.

effect is a relatively strongly reduced supply in the higher brackets, where wages must be pushed upwards in order for labor markets to be in equilibrium.

Table 2 shows the main results. Using the general equilibrium outcomes we calculate the comparative static of increasing each individual's ability level (by a specific number of standard deviations of its distribution). We compute the resulting average increase in wages for several cases that differ from each other only in the presumed number of wage brackets. In our computations we include all individuals, i.e. also the ones that will enter into entrepreneurship. The main result that we want to emphasize is that a higher level of control (i.e. more wage brackets) tends to yield a higher increase in wages. This result is consistent with the control hypothesis: more control leads to higher returns to ability.

——[TABLE 2]——

Figure 2 plots the wage brackets and the profit lines for five brackets (dotted lines) and ten brackets (solid lines). It shows that the increased return to ability when increasing the number of wage brackets is explained by an increase in the top wages. The lowest brackets remain unaffected by increasing the number of different tasks.

Two more results can be seen from *Table 2*. First, we can conjecture that the effect of control on returns to ability is concave. Consider the case where we add 1/4 standard deviations to ability. Going from 3 to 5 brackets (i.e. less than double) increases the returns to education with some 20 percent, whereas the increase is about 15 percent when we go from 5 to 10 brackets (i.e. double). We can also see that control has a larger effect when the returns to scale parameter is low. Low returns to scale decreases the ratio of profit for a high and a low skilled entrepreneur, thus yielding more entry also in lower brackets. Entry of entrepreneurs tends to decrease supply of labor and drive up wages. This difference can be seen from the general equilibrium for $\gamma = 0.75$ and $\gamma = 0.5$ shown in *Figure 3*.

———[FIGURE 2]———

———[FIGURE 3]———

In *Table 3* and *Table 4* we change the underlying distribution, by increasing the (mean preserved) spread (σ) and then by giving it a right or left skew (λ). This is done to assess to what extent the main result is dependent on or affected by distributional assumptions.

As the spread of the distribution increases, the aggregate income becomes higher, as well as the difference in average returns for employees and entrepreneurs.[14] For our purposes it is important to note that the returns to ability is increasing in the number of brackets, for whatever size of the variance of the underlying distribution. Moreover, from *Table 3* we can also see that the returns to ability is higher when the variation is large. This is intuitive because wage differentials can be larger in a distribution with larger spread. *Table 3* also shows that the positive effects on returns to ability of the variance and the number of wage brackets interact: with larger variance the effect of increasing the number of wage brackets on the returns to ability becomes larger.

Next we give the distribution a right or a left skew. Given an invariant underlying distribution we may interpret this as giving the population a more egalitarian or elitist treatment. We can think of this as a school system where either the most talented or the ones with the weakest talents are furthered the most. A more elitist system (right skew) increases aggregate income and income inequalities in T*able 4*. Again, this is an effect of making the upper tail thicker and thereby increasing the ability levels of entrepreneurs. Moreover, we see that our result that more brackets increase the return to ability holds irrespective of the skewness. This result is stronger in the distribution with a right skew. This is again a reflection of an increased inequality in wages as the wage structure becomes more convex.

———[TABLE 3]———

———-[TABLE 4]———

[14]The latter effect is explained by the fact that entrepreneurs are overrepresented in the upper tail of the distribution. More highly skilled entrepreneurs also explains why a larger spread increases aggregate income.

5 Conclusions

When asked for reasons why becoming an entrepreneur, control is frequently mentioned. Is this more than a matter of preferences? Empirical evidence suggests that this is indeed the case: entrepreneurs tend to have a higher return to their human capital assets than employees. A highly intuitive explanation for this fact is that as an entrepreneur individuals are better able to control their human capital assets and put it to use. Wage workers are constrained by assigned tasks and work descriptions. Together with labor market rigidities this lowers the correlation between ability and remuneration.

In this article we have explored one way of integrating the idea of different levels of control in a general equilibrium framework. In this model workers who are heterogenous in ability may be assigned to the same wage bracket. In a given structure of brackets some ability levels will be over and some undercompensated relative to their productivity. We can vary the degree of control by varying the number of of exogenously given wage brackets.

With this model we can show that the returns to ability are higher for wage workers when the number of brackets increase. This is consistent with the idea of limited control as the basis for a distinction between wage workers and entrepreneurs in terms of their returns to ability. We thus show a way of integrating the concept of control in a widely used occupational choice model. By doing so we provide a theoretical underpinning for the control-based explanation of the empirical observation that the returns to ability and education are higher for entrepreneurs than for employees.

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Appendix A

Iterative Procedure to find the equilibrium

1. Guess a wage level for each bracket.

2. Trace out breakpoints using the occupational choice condition. If no entry into entrepreneurship occurs in any bracket, renew guess.

3. Iterate step 4 and 5 over all brackets, beginning with the first.

4. Find new wage that equilibrates bracket j, using labor market clearing condition (leaving out occupational choice condition). Since changing this wage will affect other brackets because the market clearing condition does not take into account the movement in breakpoints that will occur due to the change in wages. Hence wages must be changed marginally. If the equilibrium wage is higher than the previous wage, increase w_j by some small $\varepsilon > 0$. If it is lower, decrease it with the same amount.

5. Trace out new breakpoints for all brackets using the occupational choice condition.

6. Test if labor markets clear with new breakpoints. Repeat until convergence.

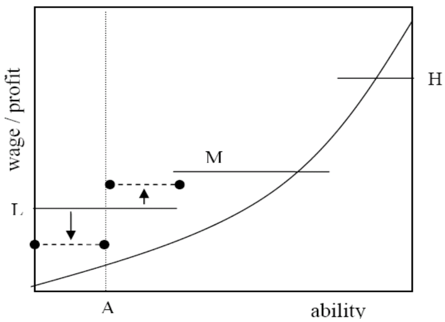

Figure 1a. Direct effects of subdividing a wage bracket.

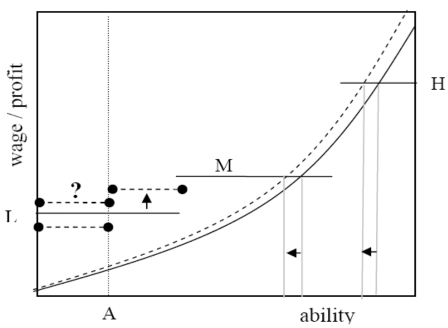

Figure 1b. Indirect effect on labor demand from subdividing a wage bracket.

Figure 1: General equilibrium effects of dividing wage brackets.

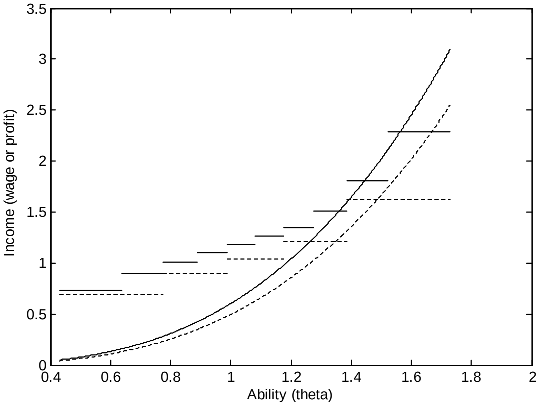

Figure 2: Wage levels and profit function for n=5 (dotted lines) and n=10 (solid lines).

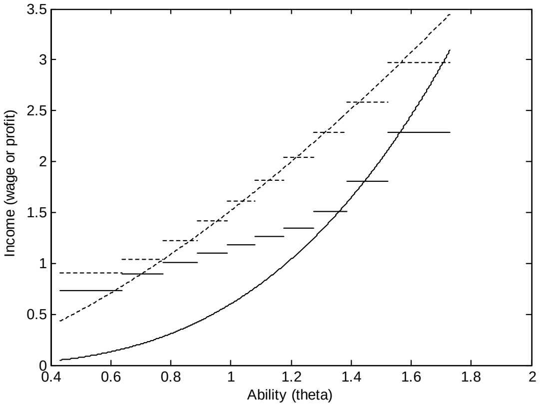

Figure 3: Wage levels and profit function for n=10 comparing γ=0.75 (solid lines) with γ=0.5 (dotted lines).

Table 1: General equilibrium properties

	$\gamma = 0.75$				$\gamma = 0.9$			
	2	3	5	10	2	3	5	10
Agg. wage	0.687	0.759	0.855	1.012	1.045	1.088	1.145	1.226
Agg. profit	0.229	0.253	0.285	0.337	0.116	0.121	0.127	0.136
Agg. income	0.916	1.012	1.140	1.349	1.161	1.209	1.272	1.362
Share entrepreneurs	0.168	0.155	0.153	0.150	0.062	0.059	0.056	0.052
Avg. wage	0.826	0.898	1.010	1.191	1.113	1.156	1.213	1.293
Avg. profit	1.368	1.634	1.861	2.245	1.887	2.067	2.286	2.617

Mean 1.08, std.dev 0.32.

Table 2: Returns to ability

	$\gamma = 0.75$				$\gamma = 0.9$			
	2	3	5	10	2	3	5	10
Increase in wage								
+1/4 std.dev. ability	4.47	5.82	6.98	8.05	4.72	5.78	6.52	7.14
+1/2 std.dev. ability	8.79	11.47	13.84	16.55	9.28	11.31	12.72	14.33
+1 std.dev ability	16.46	21.69	28.02	34.15	17.38	21.08	25.04	27.78

Mean 1.08, std.dev 0.32.

Table 3: Change (mean preserving) spread of distribution

	$\sigma = 0.25$		$\sigma = 0.5$		$\sigma = 1$	
	3	10	3	10	3	10
Agg. income	0.955	1.276	1.012	1.349	1.026	1.368
Avg.wage/Avg.profit	0.588	0.590	0.549	0.531	0.552	0.532
Increase in wage						
+1/4 std.dev. ability	4.56	6.06	5.82	8.05	6.29	9.05
+1/2 std.dev. ability	8.98	12.59	11.47	16.55	12.51	18.28
+1 std.dev ability	16.91	26.84	21.69	34.15	24.51	36.23

Mean1.08, std.dev0.21(σ=0.25),0.32(σ=0.5),0.36(σ=1).

Table 4: Change skewness of distribution

	$\lambda = -1$		$\lambda = 0$		$\lambda = 1$	
	3	10	3	10	3	10
Agg. income	1.024	1.365	1.012	1.349	1.002	1.340
Avg.wage/Avg.profit	0.552	0.538	0.549	0.531	0.594	0.629
Increase in wage						
+1/4 std.dev. ability	6.24	8.59	5.82	8.05	5.47	7.63
+1/2 std.dev. ability	12.35	17.67	11.47	16.55	10.72	24.09
+1 std.dev ability	23.48	36.37	21.69	34.15	20.11	32.02

Mean 1.07, std.dev 0.35 skew 0.08 ($\lambda = -1$)
Mean 1.09, std.dev 0.30 skew -0.14 ($\lambda = 1$)

Essay IV

Entrepreneurial Innovations, Entrepreneurship Policy and Globalization*

Robin Douhan†, Pehr-Johan Norbäck and Lars Persson

Research Institute of Industrial Economics (IFN)

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Abstract

What explains the world-wide trend of pro-entrepreneurial policies in the last few decades? We study entrepreneurial policy in a lobbying model taking into account the conflict of interest between entrepreneurs and incumbents. It is shown that international market integration leads to more pro-entrepreneurial policies. It becomes more difficult to protect the profits of incumbent firms from entrepreneurial entry and pro-entrepreneurial policies make foreign entrepreneurs less aggressive. Making use of the Doing Business database, we find, consistent with our theory, evidence that international openness reduces barriers to entry for new entrepreneurs and that the effect is stronger in countries with more rent-seeking governments.

JEL codes: L26; L51; O31; F15; D73

Keywords: Entrepreneurship; Regulation; Innovation; Market Integration; Lobbying

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†Robin sadly passed away in August 2009. His friendship, kindness and talent will be deeply missed.

1. Introduction

In the last few decades, entrepreneurship has emerged as a key issue in the policy arena.[1] This marks a distinct break against traditional industrial policy which has focused on large established firms. The magnitude of the shift towards more pro-entrepreneurial policies is revealed in data from the World Bank's *Doing Business* project. Figure I shows how the costs incurred in the process of a start-up of a new firm, as a share of the country's GDP per capita, in 72 countries have evolved over recent years (Djankov *et. al*, 2002). On average, the cost of starting a new business declined by more than 6 percent per annum over the period 2003-08. Panel B of Figure I shows that the decline among OECD countries has been even more dramatic.

—— [FIGURE I] ——

We propose that the shift towards more pro-entrepreneurial policies can be explained by international market integration. The starting point of the analysis is the process of international integration of product and innovation markets during the last few decades, which has been driven both by policy changes such as WTO agreements (e.g. TRIPS) and the EU single market program, and by technology advances reducing international transportation and transaction costs.

Can international market integration affect entrepreneurship policy? Industrial policy as endogenous outcomes of international integration has previously been studied in the two large literatures on international R&D competition and lobbying for protection; emanating from seminal contributions by Brander and Spence (1983) and Grossman and Helpman (1994). However, these literatures have abstracted from the entrepreneur as a source of innovations. We study the effects of international integration on entrepreneurial policies taking into account the within-country conflict of interest between independent entrepreneurs and incumbent firms. The latter have an incentive to protect their position

[1] *The Economist* (14th March 2009) recently published a special report on entrepreneurship, "Global Heroes", describing this phenomenon.

on the product market and to preserve status quo, they can lobby a policy maker to set a fee (barriers) on entrepreneurial entry.

Comparing policy outcome in autarchy with outcome in a situation where product markets and innovation markets are integrated, we establish two mechanisms that make the policy more pro-entrepreneurial as markets integrate internationally. First, integration implies that incumbents now also face the threat that foreign innovation may challenge their position. This *foreign innovation threat effect* reduces the incentive to lobby for protection against the domestic entrepreneur. Second, integration introduces an interaction between entrepreneurs in different countries since the value of one innovation depends on the presence on rivalling innovations. This *strategic innovation effort effect* tends to push policies in a pro-entrepreneurial direction. The reason is that erecting barriers against the domestic entrepreneur has the negative side effect of making market entry more profitable for foreign innovators.

We also identify counteracting effects of international market integration that could make policies more anti-entrepreneurial. If integration increases incumbents' total profits, this enhances their willingness to pay to protect their market. However, we show that this *market size effect* is dominated by the *foreign innovation threat effect* and the *strategic innovation effort effect* as long as the integrated product market does not become too concentrated due to mergers and exits.

With respect to lobbying, governments differ substantially in how sensitive they are to the interest of less organized agents in the economy, notably consumers. Consumer welfare considerations are likely to induce more pro-entrepreneurial policies, since innovations benefit consumers through lower prices and a higher quality of products. The importance attached to consumer welfare is shown to affect international integration; the more weight a government puts on consumer welfare, the weaker is the reduction in entrepreneurial fees due to integration of markets. This is due to an international *consumer welfare free-riding effect* of foreign innovations.

We test the prediction of a negative relationship between barriers to entry for entrepreneurs and international market integration using the *Doing Business* cost of starting a firm as a measure of entrepreneurship policy. Our theoretical concept of international integration entails both the integration of product markets and innovation markets. Consistent with this, we draw on broad indices of globalization in the empirical analysis, using the kof index, provided by the Swiss Federal Institute of Technology in Zurich, and the csgr index, provided by University of Warwick. Both indices cover more than 120 countries over the period 1999-2004 and combine components of trade flows and foreign direct investment (FDI) flows, data on international personal contacts and information flows and involvement in international organizations.

We find a strong negative correlation between barriers to entry for entrepreneurs and the degree of international integration of the respective countries. More open countries have lower barriers to entry for new firms. This correlation holds within countries over time, also when controlling for a general time trend. It is also robust to including country-specific measures of general institutional liberalization. We also find evidence that countries with governments that are likely to put less emphasis on consumer welfare (more corrupt countries) reduce their entrepreneurship policies much more in response to an increase in integration.

Moreover, using the fact that ten countries in our sample entered the European Union in 2004, we can devise a difference-in-difference approach. We argue that the selection of new members was exogenous and that new EU-members were integrated on the common market but not forced to reduce barriers to new firm entry. The steep decline in barriers to entry in the ten countries, subsequent to becoming members, can thus be interpreted as a causal effect of integration on entrepreneurship policy.

Innovations introduced by independent entrepreneurs, and the start-up of new firms, play an important role in an economy's innovation system.[2] Indeed, the entrepreneurship literature has proposed that the entrepreneur has returned as a prominent player in the economy's innovation system in the last few decades (Baumol 2002, 2004; Loveman and Sengenberger, 1991). One of the most frequently cited reasons for the increased

[2] Moreover, using a sample period of 1965-1992, Kortum and Lerner (2000) found that VC investments, which support small innovative firms, have a positive impact on patent count at the industry level, and that this positive impact is larger than that of R&D expenditures. Hirukawa and Ueda (2008) find similar results when extending the sample period to 2001.

importance of entrepreneurship is globalization (e.g. Gilbert *et al.*, 2004). The specific link between globalization and actual policy outcome has nevertheless been neglected. We contribute to this literature by providing a theory explaining the pro-entrepreneurial policy shift as a response to international market integration and providing empirical support for the proposed mechanism.

Our paper relates to the literature on international protection for sale (Grossman and Helpman, 1994; Imai, Katayama and Krishna, 2008; Bombardini, 2008; Goldberg and Maggi, 1999).[3] This literature has shown that higher import penetration reduces the incentive for import protection in industries that wield political influence. We differ from this literature by treating the level of trade protection as exogenous. Instead, we focus on the effect of internationalization on incumbents' incentives for protection against domestic entrepreneurial entry. By showing that domestic entry barriers can be lowered due to international integration, we provide an additional channel through which globalization affects economic policy.

This paper also contributes to the literature on international R&D policy competition (e.g. Brander and Spence, 1983; Eaton and Grossman, 1986; Grossman and Helpman, 1991; Haaland and Kind, 2008; Leahy and Neary, 2008). This literature has explored how international competition affects incentives for governments to subsidize incumbent R&D and has identified a "business stealing effect" that increases the incentive for R&D subsidies when international competition increases. We differ by examining the effects of R&D policy when R&D is conducted by independent entrepreneurs rather than incumbents.[4] We then add to this literature by showing that international market integration

[3] Our paper is also related to the literature on financial development and internationalization, in particular Rajan and Zingales (2003). They present empirical evidence that openness can explain the development of financial markets over long periods of time. Perotti and Volpin (2007) and Bebchuk and Neeman (2007) formally endogenize investor protection in models with interest groups.

[4] An exception is Impullitti (2009) which, to our knowledge, is the only paper in the endogenous growth literature studying how R&D subsidies (policy) are affected by international competition, and which allows both entrants and incumbents to undertake R&D. Focusing on long-run dynamic effects, the author solves the model by calibration and shows that increased foreign competition (more foreign firms) increases R&D subsidies due to a business stealing effect (our strategic innovation effort effect) and a growth effect. We differ by focusing on the direct effect which enables us to derive analytical solutions and empirically testable predictions. Moreover, studying the effects of both product market and innovation market integration enables us to identify four different effects of international integration: a foreign innovation threat effect and a strategic innovation effort effect which increase R&D subsidies and a market size effect and a consumer welfare free-riding effect that may reduce R&D subsidies.

can increase the incentive for pro-entrepreneurial policies (e.g. R&D subsidies) due to a foreign innovation threat effect and a strategic innovation effort effect (similar to the business stealing effect) and by providing empirical support for the proposed mechanism.

To the best of our knowledge, this paper provides the first theoretical and empirical work explaining the variation in formal entry barriers over time. The data on entry regulation from the World Bank's *Doing Business* survey has been extensively used in the literature (for an overview, see the Appendix, Table A.2). Primarily, it has been used to study the effect of institutions on growth (Freund and Bolaky, 2008), corruption (Svensson, 2005) and industrial structure and dynamics (Klapper, Laeven and Rajan, 2006; Barseghyan, 2008; Ciccone and Papaopannou, 2007).[5] Although the correlation between openness and entry barriers has been noted in earlier literature, the entry costs have been treated as an exogenous underlying institutional feature.

The model is spelled out in Section 2. Section 3 studies how international market integration affects the incentive to set entrepreneurial policy. We extend the base model in Section 4. The extensions we consider are: (i) policy competition between governments, and (ii) entrepreneurial innovation for sale instead of entry. The empirical analysis is conducted in Section 5. Section 6 concludes the paper.

2. Entrepreneurship policy in autarchy

We begin by considering an industry in autarchy and then turn to examining the effect of globalization. Consider a closed oligopolistic industry with n domestic incumbents and a domestic entrepreneur who can potentially enter the market. In stage 1, the incumbents and the entrepreneur lobby in order to influence a policy maker. The policy implemented affects the profitability of entrepreneurial ventures through an entry fee. The policy maker's objective is to maximize lobbying contributions and revenues from the entry fee (subsidy). In stage 2, the entrepreneur expends effort to increase the probability of making an innovation with a fixed quality $k > 0$. In stage 3, a successful entrepreneur

[5] Helpman, Melitz and Rubinstein (2008) used entry barriers to construct an instrumental variable for the existence of bilateral trade between two partners. They argue that high entry costs in two countries substantially reduce the probability of the two countries exporting to each other.

enters the market and in stage 4, the entrepreneur competes with incumbents on the oligopolistic product market. If the entrepreneur is not successful, incumbents remain in *status quo*. We proceed by solving the game backwards.

2.1. Product market interaction (stage 4)

Firms are indexed $j \in \mathcal{I} \cup E$ where the entrepreneurial firm is assigned the index $j = E$ and the set of index numbers for domestic incumbent firms is $j = i \in \mathcal{I}$. The product market profit of firm j is represented by $\pi_j(\mathbf{x} : k)$, where $k > 0$ is the inherent quality of the innovation used by an entrepreneurial firm. The vector $\mathbf{x}$ contains actions for all firms selling to the product market. Firm j chooses an action $x_j \in R^+$ to maximize its product market profit $\pi_j(\mathbf{x} : k)$. Action x_j may be considered as setting a quantity or a price; exit is equivalent to inaction.

We assume there to exist a unique Nash-Equilibrium, defined as:

$$\pi_j(\tilde{x}_j, \tilde{x}_{-j} : k) \geq \pi_j(x_j, \tilde{x}_{-j} : k), \tag{2.1}$$

where $\tilde{x}_{-j}$ is the set of optimal actions taken by j's rivals. From (2.1), we can define a reduced-form product market profit for a firm j,

$$\pi_j(k) \equiv \pi_j(\tilde{x}_j(k), \tilde{x}_{-j}(k) : k). \tag{2.2}$$

We need to distinguish between two states: one where entrepreneurial entry has occurred and one where all firms are incumbents. When entry by the entrepreneur occurs in stage 3, the interaction involves firms indexed $j \in \mathcal{I} \cup E$. Thus, there are two types of firms: one is the entrepreneurial firm which is making a profit $\pi_E^{Aut}(k) \geq 0$, and the other is an incumbent firm with a profit $\pi_i^{Aut}(k) \geq 0$. When no entry takes place, incumbents have the profit $\pi_i^{Aut}(0) \geq 0$. The argument $k = 0$ indicates that the entrepreneur has not entered the market.

The profits of both the entrepreneur and the incumbent firms are dependent on the quality of the innovation, k. The innovation enables the entrepreneur to enter the market and make a profit, $\pi_E(k) > F > \pi_E(0)$. But entry will also reduce the incumbents' profit and possibly lead to exits of incumbents. As the quality of the innovation improves, the entrepreneurial firm will strengthen its position vis-à-vis incumbent firms, which will further reduce the incumbents' profits and possibly lead to further exit. Let $\Pi_I(0) = \sum_i^n p_i(0)\pi_i(0)$ be the expected aggregate incumbent profit where $p_i(0)$ is the probability that incumbent i remains on the market. Moreover, let $\Pi_I(k) = \sum_i^n p_i(k)\pi_i(k)$ be the expected aggregate incumbent profit where $p_i(k)$ is the probability that incumbent i remains on the market under entry. We then assume that incumbents' aggregate expected profits are reduced by entrepreneurial entry, $\Pi_I^{Aut}(0) > \Pi_I^{Aut}(k)$. Thus, the aggregate expected profit of incumbent firms will be smaller if the entrepreneur participates in the product market competition. This yields incentives for incumbents to lobby against innovation.

2.2. Entry by entrepreneur (stage 3)

In stage 3, a successful entrepreneur enters the market if the fixed cost of entry F is lower than the subsequent product market profit. In what follows, we will assume k to be sufficiently large so that entry always occurs when the entrepreneur succeeds with its innovation, $\Pi_E^{Aut}(k) = \pi_E^{Aut}(k) - F > 0$.

2.3. Innovation (stage 2)

The entrepreneur undertakes an effort, e, to discover an innovation with fixed quality, k. Let innovation costs $y(e)$ be an increasing convex function in effort, i.e. y', $y'' > 0$. The probability of making an innovation is given by a function $z(e) \in [0, 1]$, where z is an increasing concave function in own effort, $z' > 0$, $z'' < 0$. Inactivity is a feasible action for the entrepreneur with $z(0) = 0$ and $y(0) = 0$. The entrepreneur makes an effort decision given an entry fee policy τ set by the government policy in stage 1. The policy reduces the profit by a fixed amount τ, if the entrepreneur innovates successfully. A fixed τ is assumed since it fits our empirical data. Alternatively, we could set τ to be proportional to entrepreneurial profits. This adds a scaling effect, but does not change any signs of our results.[6]

The entrepreneur then solves the following problem,[7]

$$\max_{e} : W_E = z(e)\left[\Pi_E^{Aut}(k) - \tau\right] - y(e), \tag{2.3}$$

with the first-order condition:

$$\frac{dW}{de} = z'_e \left[\Pi_E^{Aut}(k) - \tau\right] - y'_e = 0, \tag{2.4}$$

which implicitly defines an optimal effexort level $e(\tau)$. The optimal effort level is decreasing in the entry fee, $e'_\tau < 0$.[8] Since $z(\tau) = z(e(\tau))$, with $z'_\tau = z'_e e'_\tau < 0$, the probability of a successful innovation is also decreasing in the entry fee.

To proceed, it will be useful to define the reduced-form expected profits for the entrepreneur and the incumbents, respectively, as a function of the entry fee τ:

$$\begin{cases} W_E^{Aut}(\tau) = z(\tau)\left[\Pi_E^{Aut}(k) - \tau\right] - y(\tau), \\ W_I^{Aut}(\tau) = \left[1 - z(\tau)\right]\Pi_I^{Aut}(0) + z(\tau)\Pi_I^{Aut}(k). \end{cases} \tag{2.5}$$

2.4. Entrepreneurial policy (stage 1)

We will assume a rent maximizing government (in Section 3.6 we will examine the case of a total surplus maximizing government). The objective function of the policy maker G is the sum of social welfare and the sum of lobbying contributions from entrepreneurs and incumbents:

$$G = W(\tau) + \sum_{h=I,E} L_h(\tau), \tag{2.6}$$

where $W(\tau) = \tau z(\tau)$, i.e. social welfare is simply the government expected income from entry fees. We assume that incumbent firms can organize themselves as an interest group

[6] Derivations are available from the authors upon request.

[7] Note that the entrepreneur's profit is reduced by the amount spent on lobbying. In stage 2, this is a sunk cost which does not enter into the entrepreneur's problem.

[8] Which directly follows from differentiation of (2.4) and the assumptions on $z(.)$ and $y(.)$.

and make a joint lobbying contribution. Hence, the entrepreneur and the incumbent lobbying group give the government a contribution schedule, $L_E(\tau)$ and $L_I(\tau)$, respectively. For all values of τ, these schedules give the lobbying contribution each party is willing to pay.

The lobbying contribution from group h, $L_h(\tau)$, is derived as follows. Let $G_{-h}(\tau) = L_{-h}(\tau) + W(\tau)$ be the government's objective function when group h does not lobby, and define the optimal fee for the policy maker without group being h present as $\tau_{-h}^{Gov} = \arg\max_\tau G_{-h}(\tau)$. Then, group h can only induce the government to choose another policy $\tau \neq \tau_{-h}^{Gov}$ by compensating the government by an amount:

$$C_h(\tau) = G_{-h}(\tau_{-h}^{Gov}) - G_{-h}(\tau). \tag{2.7}$$

Given the lobbying contribution offered by the other lobby group, the optimal entry fee for group h is then $\tau_h^{opt} = \arg\max_\tau W_h^{Aut}(\tau) - C_h(\tau)$, where $W_h^{Aut}(\tau)$ is given from (2.5). Which lobbying contribution will then be chosen? We will restrict the lobbying contributions to be "regret free" or "truthful". This implies that we restrict the set of possible lobbying offers $L_h(\tau)$ to those for which a lobby group gets at least its optimal net welfare, $\bar{\Omega}_h = W_h^{Aut}(\tau_h^{opt}) - C(\tau_h^{opt})$, or:

$$W_h^{Aut}(\tau) - L_h(\tau) = W_h^{Aut}(\tau_h^{opt}) - C(\tau_h^{opt}) = \bar{\Omega}_h. \tag{2.8}$$

Given that the contributions $L_h(\tau)$ are such that the entrepreneur ($h = E$) and the incumbent firms ($h = I$) are both indifferent between the offered fee τ and their optimal fees τ_h^{opt}, (2.8) constitutes a Nash-equilibrium in offered lobbying schedules (Bernheim and Whinston, 1986; Grossman and Helpman, 1994). From (2.8), we can now solve for the equilibrium lobbying contribution $L_h(\tau)$:

$$L_h(\tau) = W_h^{Aut}(\tau) - \bar{\Omega}_h. \tag{2.9}$$

Inserting (2.9) into (2.6), we can rewrite the objective function as:

$$G(\tau) = \tau z(\tau) + W_I^{Aut}(\tau) + W_E^{Aut}(\tau) - \bar{\Omega}_I^{Aut} - \bar{\Omega}_E^{Aut}. \tag{2.10}$$

The policy maker sets a fee τ so as to maximize $G(\tau)$ and thereby, from (2.9), implicitly also the lobbying contributions of the entrepreneur, $L_E(\tau)$, and the incumbent firms, $L_I(\tau)$. The first-order condition of (2.10), using (2.5) and taking into account the optimal effort by the entrepreneur in (2.4), is:

$$\frac{dG}{d\tau} = \underbrace{z'_\tau \tau}_{\text{Exp. loss (fee)}} \quad \underbrace{-z'_\tau \left[\Pi_I^{Aut}(0) - \Pi_I^{Aut}(k)\right]}_{\text{Exp.gain (incumbents)}} = 0. \tag{2.11}$$

An increase in entry fees will reduce the entrepreneurial effort and hence, decrease the probability of a successful innovation, $z'_\tau = z'_e e'_\tau < 0$. The first term reflects the consequences of this in terms of reduced policy revenues, $z'_\tau \tau^{Aut} < 0$. The second term represents the increase in the incumbents' expected profit and hence, the increase in lobbying contributions from incumbents, when the probability of a successful innovation (and hence of entrepreneurial entry) declines, $-z'_\tau n \left[\pi_I^{Aut}(0) - \pi_I^{Aut}(k)\right] > 0$. From (2.11), we obtain the optimal policy in autarchy:

$$\tau^{Aut} = \Pi_I^{Aut}(0) - \Pi_I^{Aut}(k) > 0. \tag{2.12}$$

In autarchy the fee will, in other words, be set equal to the loss of incumbents caused by an innovation.

3. Globalization and barriers to entrepreneurship

Let us now examine the impact of globalization on the optimal entry fees, τ. For expositional reasons, we first model the optimal entry fee in one country, taking the entrepreneurial policy in the rest of the world as given, $\bar{\tau}^*$. This assumption is relaxed in Section 3.5. We capture globalization as an integration of product and innovation markets. Product market integration is modeled as competition between firms, domestic and foreign, on an integrated product market. Innovation market integration is captured by competition between domestic and foreign entrepreneurs for making innovations and thus a subsequent market entry. We will assume that entrepreneurial entry on the integrated product market requires a global patent for the innovation, k. Even if entrepreneurs from both countries are successful, only one of them will obtain a global patent (and enter the product market). This patent right is then allocated by a 50-50 lottery. Other assumptions that we impose are that neither incumbents nor entrepreneurs can engage in cross-border lobbying and that the policy makers in the two countries are not able to cooperate. We discuss the effects of cross-border lobbying in Section 4.1.

3.1. Integration of product markets (stage 4)

In the integrated product market, let the set of indices for foreign incumbents and the entrepreneur be denoted I^* and E^*, while I and E represent domestic incumbents and the entrepreneur, respectively. Product market competition may then entail firms indexed $j \in I \cup I^*$, $j \in I \cup I^* \cup E$ or $j \in I \cup I^* \cup E^*$. In either case, the Nash-equilibrium is given as:

$$\pi_j^{Int}(\tilde{x}_j, \tilde{x}_{-j} : k) \geq \pi_j^{Int}(x_j, \tilde{x}_{-j} : k), \tag{3.1}$$

from which we define a reduced-form profit $\pi_j^{Int}(k) \equiv \pi_j^{Int}(\tilde{x}_j(k), \tilde{x}_{-j}(k) : k)$. In what follows, we will once more assume that incumbents' aggregate expected profits are reduced by entry, i.e. $\Pi_I^{Int}(0) > \Pi_I^{Int}(k)$.

3.2. Entry (stage 3)

In stage 3, a successful entrepreneur enters the market at a fixed cost. It is once more assumed that $\Pi_E^{Int}(k) = \pi_E^{Int}(k) - F > 0$ if the domestic entrepreneur is successful, and $\Pi_{E^*}^{Int}(k) = \pi_{E^*}^{Int}(k) - F^* > 0$ if a foreign entrepreneur is successful.

3.3. Entrepreneurial innovation (stage 2)

The domestic and foreign entrepreneur both expend effort to innovate. Let the effort by the foreign entrepreneur be denoted e^*. The foreign entrepreneur's probability of success is determined by the same function as that of the domestic entrepreneur, $z(\cdot)$. We can then write the probability that the domestic entrepreneur successfully enters as $z_E^{win}(e, e^*) = z(e)[1 - z(e^*)] + 0.5z(e)z(e^*)$, where $z(e)[1 - z(e^*)]$ is the probability of entry if the domestic entrepreneur alone is successful and $0.5z(e)z(e^*)$ is the probability of the domestic entrepreneur winning the lottery in case of simultaneous innovations. Simplifying, we obtain $z_E^{win}(e, e^*) = z(e)[1 - 0.5z(e^*)]$. The probability that the foreign entrepreneur enters the integrated market is symmetric, $z_{E^*}^{win}(e, e^*) = z(e^*)[1 - 0.5z(e)]$.

In the integrated market, we can write the entrepreneurs' maximization problems as follows:

$$\max_e W_E = z_E^{win}(e, e^*)\left[\Pi_E^{Int}(k) - \tau\right] - y(e), \tag{3.2}$$

$$\max_{e^*} W_{E^*} = z_{E^*}^{win}(e, e^*)\left[\Pi_E^{Int}(k) - \bar{\tau}^*\right] - y(e^*). \tag{3.3}$$

The Nash-equilibrium in efforts is given from:

$$\frac{\partial W_E}{\partial e} = z_e'(1 - 0.5z^*)\left[\Pi_E^{Int}(k) - \tau\right] - y_e' = 0, \tag{3.4}$$

$$\frac{\partial W_{E^*}}{\partial e^*} = z_{e^*}'(1 - 0.5z^*)\left[\Pi_{E^*}^{Int}(k) - \bar{\tau}^*\right] - y_{e^*}' = 0. \tag{3.5}$$

From (3.4) and (3.5), the optimal entrepreneurial efforts can be derived as functions of the domestic entry fee, $e(\tau)$ and $e^*(\tau)$. In the Appendix, we show that (3.4) and (3.5) imply that entrepreneurial efforts e and e^* are strategic substitutes:[9] more effort expended by the foreign entrepreneur, e^*, reduces the effort of the domestic entrepreneur, e. It also follows that an increase in the entry fee τ for the domestic entrepreneur must reduce the optimal effort by the domestic entrepreneur, while increasing the optimal effort of its

[9] If entrepreneurial effort instead involved spill-overs, thus enhancing the performance of the other entrepreneur, we could have a situation where entrepreneurial efforts are strategic complements. This would change the sign on the *strategic innovation effort effect* discussed in the next subsection .

foreign rival, $e'_\tau < 0$ and $e^{*\prime}_\tau > 0$. Noting that $z(\tau) = z(e(\tau))$ and $z^*(\tau) = z(e^*(\tau))$, and assuming that the stability criteria of the Nash-equilibrium in (3.4) and (3.5) are met, we have the following result:

Lemma 1. *Increasing the entry fee τ for the domestic entrepreneur increases the effort by the foreign entrepreneur and the probability of foreign entry, while decreasing the effort level and the probability of domestic entry, $z'^*_\tau = z'_{e^*} e^{*\prime}_\tau > 0$ and $z'_\tau = z'_e e'_\tau < 0$.*

Proof. See the Appendix. ■

Once more, it will be useful to define a reduced-form expected profit for the entrepreneur and the incumbents as a function of the entry fee, τ. Let $z_E^{win}(\tau)$ be the reduced-form probability that the domestic entrepreneur wins and let $z^{entry}(\tau)$ be the reduced-form probability that either the domestic or the foreign entrepreneur enters the product market:

$$\begin{cases} z_E^{win}(\tau) = z(e(\tau))\left[1 - 0.5z(e^*(\tau))\right] \\ z^{entry}(\tau) = 1 - \left[1 - z^*(\tau)\right]\left[1 - z(\tau)\right]. \end{cases} \tag{3.6}$$

We then have:

$$\begin{cases} W_E^{Int}(\tau) = z_E^{win}(\tau)\left[\Pi_E^{Int}(k) - \tau\right] - y(\tau), \\ W_I^{Int}(\tau) = \left[1 - z^{entry}(\tau)\right]\Pi_I^{Int}(0) + z^{entry}(\tau)\Pi_I^{Int}(k). \end{cases} \tag{3.7}$$

3.4. Entrepreneurial Policy (Stage 1)

In the integrated market, each government maximizes the sum of social welfare and the sum of lobbying contributions from entrepreneurs and incumbents, choosing its entry fee taking as given the entry fee of the other government. To highlight the effects of globalization, assume that only domestic firms can lobby against the domestic policy maker. As previously mentioned, for expositional reasons we first model the optimal entry fee in one country taking the entrepreneurial policy in the rest of the world as given, $\bar{\tau}^*$. These assumptions are relaxed below.

The lobbying game then has the same structure as in autarchy. Thus, in integrated markets, the objective function of the policy maker in (2.10) now becomes:

$$\max_{\tau} G = z_E^{win}(\tau)\tau + W_I^{Int}(\tau) + W_E^{Int}(\tau) - \bar{\Omega}_I^{Int} - \bar{\Omega}_E^{Int}, \tag{3.8}$$

where (with a slight abuse of notation) $\bar{\Omega}_h^{Int} = W_E^{Int}(\tau_h^{opt}) - C_h(\tau_h^{opt})$ are constants defined as the optimal (net) profit for the entrepreneur and the incumbent lobby.

Using the entrepreneur's optimality condition (3.4), the reduced-form probabilities in (3.6) and (3.7), the policy maker's first-order condition is:

$$\begin{aligned}\frac{\partial G}{\partial \tau} \quad = \quad & \underbrace{z_\tau'(1-0.5z^*)\tau}_{\text{Expected loss (fees)}} \quad \underbrace{-z_\tau'(1-z^*)\left[\Pi_I^{Int}(0)-\Pi_I^{Int}(k)\right]}_{\text{Expected gain (incumbents)}} \\ & \underbrace{-z_\tau^{*\prime}(1-z)\left[\Pi_I^{Int}(0)-\Pi_I^{Int}(k)\right]}_{\text{Expected loss (incumbents)}} - \underbrace{0.5z_\tau^{*\prime}z\Pi_E^{Int}(k)}_{\text{Expected loss (entrepreneur)}} = 0.\end{aligned} \tag{3.9}$$

To infer the effect of globalization on entrepreneurial policy, it is instructive to compare the first-order condition under integrated markets in (3.9) to that under autarchy in (2.11).

The first line in (3.9) once more reflects the trade-off between a lower expected income from the entry fee and the increase in lobbying contributions from incumbents (when the domestic entrepreneur reduces her innovation effort in response to an increase in the fee). However, as compared to autarchy, both effects are discounted by the presence of the foreign entrepreneur, where we note that the gain in the lobby contributions is more heavily discounted than the loss in entry fees, since $(1-0.5z^*) > (1-z^*)$. The key is that incumbents lose their "gain" from domestic lobbying each time the foreign entrepreneur is successful, whereas the loss in entry fee will not be eliminated each time the foreign entrepreneur is successful, since it might lose the lottery against the domestic entrepreneur if it is also successful. This is what we refer to as the *foreign innovation threat effect.*

The second line in (3.9) adds new effects as compared to autarchy. Both represent reductions in lobby contributions due to the presence of the foreign entrepreneur. We refer to them as *strategic innovation effort effects.* The first term in the second line represents a decrease in lobbying contributions from incumbents, emerging from the fact that increasing the entry fee increases the effort by the foreign entrepreneur and hence, the probability of a foreign innovation. The second term captures an incentive for the entrepreneur to lobby more to avoid the risk of losing the patent lottery. The entrepreneur has an incentive to lobby for low fees, committing to a high effort in stage 2 and thus keeping down the effort of the foreign entrepreneur.

Let us now examine if integration reduces entry barriers. From (3.9), we can solve for the entry fee under integration and compare it to the autarchy fee in (2.12):

$$\tau^{Aut} - \tau^{Int} = \underbrace{\left[\Pi_I^{Aut}(0) - \Pi_I^{Aut}(k)\right]}_{(+)} - \{\underbrace{\lambda_I}_{\in(0,1)} \underbrace{\left[\Pi_I^{Int}(0) - \Pi_I^{Int}(k)\right]}_{(+)} + \underbrace{\lambda_E}_{(-)} \Pi_E^{Int}(k)\}. \quad (3.10)$$

In (3.10), the first term spells out the entry fee under autarchy while the second term is the entry fee under integration. In the integrated market, the entry fee trades off the reduction in incumbents' profit and the creation of entrepreneurial rents. Note that in the integrated market, the reduction in incumbents' profits is discounted by the term $\lambda_I = \frac{z'_\tau(1-z^*)+z^{*\prime}_\tau(1-z)}{z'_\tau(1-0.5z^*)}$. Since $z^{*\prime}_\tau > 0 > z'_\tau$ and $z, z^* \in [0,1]$, it follows that $\lambda_I \in (0,1)$. The term λ_I reflects a reduction in lobby contributions from incumbents which realize that stopping the domestic entrepreneur is worth less due to the probability of foreign entry. Moreover, attempts at decreasing the innovation effort of the domestic entrepreneur have the negative side effect of amplifying the risk of foreign entry. The term $\lambda_E = \frac{0.5z^{*\prime}_\tau z}{z'_\tau(1-0.5z^*)} < 0$ reflects the fact that entry fees are kept down by lobbying contributions from the domestic entrepreneur which has an incentive to avoid losing a patent lottery against the foreign entrepreneur.

From (3.10), we can state the following proposition.

Proposition 1. *If incumbent losses from entry in the integrated market* $\Pi_I^{Int}(k) - \Pi_I^{Int}(0)$ *are not substantially larger than incumbent losses from entry in autarchy* $\Pi_I^{Aut}(k) - \Pi_I^{Aut}(0)$ *then, due to a foreign innovation threat effect and a strategic innovation effort* *effect, entry barriers will be lower in the integrated market,* $\tau^{Aut} - \tau^{Int} > 0$.

Proof. Using (2.12) and (3.10), we can rewrite $\tau^{Aut} - \tau^{Int} > 0$ as:

$$\frac{\Pi_I^{Int}(k) - \Pi_I^{Int}(0)}{\Pi_I^{Aut}(k) - \Pi_I^{Aut}(0)} < \zeta = \frac{1}{\lambda_I} - \frac{\lambda_E}{\lambda_I} \frac{\Pi_E^{Int}(k)}{\Pi_I^{Aut}(k) - \Pi_I^{Aut}(0)} > 1, \tag{3.11}$$

where $\zeta > 1$ follows from noting that $\lambda_I = \frac{z'_\tau(1-z^*)+z^{*\prime}_\tau(1-z)}{z'_\tau(1-0.5z^*)} \in (0,1)$ and $\lambda_E = \frac{0.5z^{*\prime}_\tau z}{z'_\tau(1-0.5z^*)} < 0$. ■

Proposition 1 suggests that international integration will reduce the barriers to entry for entrepreneurs since such barriers, all else equal, promote opportunistic behavior by foreign entrepreneurs and reduce the lobby contributions of incumbents. The influence by the foreign entrepreneur may lead to lower entry barriers in integrated markets than in autarchy, even when incumbents' losses from entry is higher in the integrated market.

Whether incumbent losses from entry are higher in the integrated market than in autarchy depends on the underlying assumptions made in the oligopoly model. Below, we will provide a linear Cournot model where (3.11) is fulfilled and $\tau^{Aut} - \tau^{Int} > 0$. We will also use this model to show the existence of Nash-equilibrium in entry fees τ^{Int} and τ^{Int^*} such that $\tau^{Int} = \tau^{Int^*} < \tau^{Aut}$. Moreover, we will show that if international integration is followed by a sufficiently large product market concentration due to mergers or exit, international integration will increase the entry barriers, i.e. $\tau^{Aut} - \tau^{Int} < 0$.

3.5. A parametric example

In the Linear-Cournot model (LC-model), there are two symmetric countries, each with n incumbents. The oligopoly interaction in period 4 is Cournot competition in homogenous goods. The product market profit is $\pi_j^m = (P^m - c_j)q_j^m$ where firms face inverse demand $P^m = a - \frac{1}{s^m}\sum_{j=1}^{N^m} q_j$, for $m = \{Aut, Int\}$, where $a > 0$ is a demand parameter, s^m may be interpreted as the size of the market with $s^{Aut} = s$ and $s^{Int} = 2s$. N^m is the total number of firms in the market. There are no exits of incumbents. Thus, in autarchy, $N(k)^{Aut} = n + 1 > N(0)^{Aut} = n$, whereas in the integrated market, $N^{Int}(k) = 2n + 1 > N^{Aut}(0) = 2n$.

Ownership of the innovation reduces the marginal cost. Making a distinction between firm types, we have:

$$c_I = c, \qquad c_E = c - k. \tag{3.12}$$

In the LC model, (3.1) and (2.2) take the form $\frac{\partial \pi_j^m}{\partial q_j} = P^m - c_j - \frac{q_j^m}{s} = 0 \; \forall j, \; m = Aut, Int$, which can be solved for optimal quantities $\tilde{q}^m(k)$ under entry and $\tilde{q}^m(0)$ without entry. Since $\frac{\partial \pi_j^m}{\partial q_j} = 0$ implies $P^m - c_j = -\frac{q_j^m}{s^m}$, reduced-form profits are quadratic in own output, $\pi_j^m(k) = \frac{1}{s^m}\left[\tilde{q}_j^m(k)\right]^2$ and $\pi_j^m(0) = \frac{1}{s^m}\left[\tilde{q}_j^m(0)\right]^2$, with optimal quantities given as:

$$\begin{array}{lll} \tilde{q}_E^{Aut}(k) = s\frac{\Lambda+(n+1)k}{n+2} & \tilde{q}_j^{Aut}(k) = s\frac{\Lambda-k}{n+2} & \tilde{q}_j^{Aut}(0) = s\frac{\Lambda}{n+1} \\ \tilde{q}_E^{Int}(k) = 2s\frac{\Lambda+(2n+1)k}{2n+2} & \tilde{q}_j^{Int}(k) = 2s\frac{\Lambda-k}{2n+2} & \tilde{q}_j^{Int}(0) = 2s\frac{\Lambda}{2n+1}, \end{array} \tag{3.13}$$

where $\Lambda = a - c$. We have the following Lemma:

Lemma 2. *In the linear Cournot model with symmetric countries and with $\bar{\tau}^*$ being exogenous, $\Pi_I^{Aut}(k) - \Pi_I^{Aut}(0) > \Pi_I^{Int}(k) - \Pi_I^{Int}(0)$, which from (3.11) implies that $\tau^{Aut} - \tau^{Int} > 0$.*

Proof. See the Appendix. ■

By assuming a parametric form of the probability and cost functions that enter into the entrepreneur's problem, we can extend the linear Cournot model to derive a full solution to the model by solving the entry fee game between governments.

Assumption A1: The probability of a successful innovation and the effort cost is determined by $z(e) = 1 - \exp(-\gamma e^2)$ and $y(e) = \theta e^2$ for the domestic entrepreneur, and $z(e^*) = 1 - \exp(-\gamma e^{*2})$ and $y(e^*) = \theta e^{*2}$ for the foreign entrepreneur.

Assume that Assumption A1 holds. In stage 4, optimal quantities are then given from (3.13). In the integrated market, (3.4) and (3.5) give the useful relation $\frac{z_\tau'^*}{z_\tau'} = -\frac{(1-z^*)}{(2-z)}$ in stage 2. Reduced form probabilities will now include both the domestic and the foreign entrepreneurship policy:

$$\begin{cases} z_E^{win}(\tau,\tau^*) = z(e(\tau,\tau^*))\left[1-0.5z(e^*(\tau,\tau^*))\right] \\ z_{E^*}^{win}(\tau,\tau^*) = z(e^*(\tau,\tau^*))\left[1-0.5z(e(\tau,\tau^*))\right] \\ z^{entry}(\tau,\tau^*) = 1-\left[1-z^*(\tau,\tau^*)\right]\left[1-z(\tau,\tau^*)\right]. \end{cases} \tag{3.14}$$

Turning to government policies in stage 1, and assuming truthful lobbying contributions, the objective functions of the domestic and foreign government are:

$$G(\tau,\tau^*) = z_E^{win}(\tau,\tau^*)\tau + W_I^{Int}(\tau,\tau^*) + W_E^{Int}(\tau,\tau^*) - \bar{\Omega}_I^{Int}(\tau^*) - \bar{\Omega}_E^{Int}(\tau^*), \tag{3.15}$$

and:

$$G^*(\tau,\tau^*) = z_{E^*}^{win}(\tau,\tau^*)\tau^* + W_{I^*}^{Int}(\tau,\tau^*) + W_{E^*}^{Int}(\tau,\tau^*) - \bar{\Omega}_{I^*}^{Int}(\tau) - \bar{\Omega}_{E^*}^{Int}(\tau). \tag{3.16}$$

The constants entering the domestic government's problem, $\bar{\Omega}_h^{Int}(\tau^*) = W_h^{Int}(\tau_h^{opt},\tau^*) - C_h(\tau_h^{opt},\tau^*)$ and the foreign government's problem, $\bar{\Omega}_{h^*}^{Int}(\tau) = W_{h^*}^{Int}(\tau_h^{opt},\tau) - C_{h^*}(\tau_{h^*}^{opt},\tau)$, only depend on the policy in the other country. Hence, these will drop out of the first-order conditions of the two governments. The expected profits, $W_h^{Int}(\tau,\tau^*)$ and $W_{h^*}^{Int}(\tau)$, are as in (3.7), but with probabilities depending on the policies in both countries, as shown in (3.14). Deriving the reaction functions $\tau(\tau^*) = \arg\max_\tau G(\tau,\tau^*)$ and $\tau^*(\tau) = \arg\max_{\tau^*} G^*(\tau,\tau^*)$ and solving for τ and τ^*, we then have the following proposition:

Proposition 2. *In the linear Cournot model with symmetric countries and under Assumption A1, (i) the entrepreneurship policies are strategic complements, i.e.* $\frac{d\tau}{d\tau^*} > 0$ *and (ii) there exists a symmetric equilibrium* τ^{Int} *and* τ^{Int^*} *such that* $\tau^{Int} = \tau^{Int^*} < \tau^{Aut}$.

Proof. See the Appendix. ■

The propositions have hitherto been conditional on incumbents' losses due to an innovation being smaller in autarchy than in integrated markets. This hinges on assumptions regarding the relative size of the domestic and the foreign market and on the number of firms relative to market size in autarchy and in integrated markets. The larger is size of the foreign market and the fewer firms that serve it in autarchy, relative to the home country, the more likely is it that this assumption is violated. Moreover, as an implication of heterogeneous firms in a Melitz (2003) model, aggregate profit among incumbent firms may increase when markets are integrated.[10] To make this point in our Cournot model, assume that integration is followed by a sufficiently large product market concentration due to mergers or exit, leading to $m < 2n$ active firms in the international integrated markets. We can then derive the following result:

Proposition 3. *In the linear Cournot model under Assumption A1, there exists a* $\hat{m}$, $\hat{n}$ *and* $\hat{k}$ *such that for* $0 < m < \hat{m}$, $n > \hat{n}$ *and* $0 < k < \hat{k}$: $\tau^{Int} > \tau^{Aut}$.

Proof. See the Appendix. ■

3.6. A total surplus maximizing government

Let us now relax the assumption of a rent maximizing government. To highlight the effects, we once more take the foreign policy as given. Starting with autarchy, we then let social welfare be $W(\tau) = \tau z(\tau) + \alpha\{z(\tau)CS^{Aut}(k) + [1-z(\tau)]CS^{Aut}(0)\}$, i.e. social welfare is the government expected income from entry fees and the expected consumer surplus where $CS^{Aut}(0)$ denote the consumer surplus in the pre-innovation state and $CS(k)$ the consumer surplus with entrepreneurial firm entry and α is a preference parameter that shifts the importance attached to consumer welfare. Proceeding as in Section 3.4, the government's objective function in (2.10) now becomes:

$$\begin{aligned} \max_{\tau} G(\tau) &= \tau z(\tau) + W_I^{Aut}(\tau) + W_E^{Aut}(\tau) - \bar{\Omega}_I^{Aut} - \bar{\Omega}_E^{Aut} \\ &\quad + CS^{Aut}(0) + \alpha z(\tau)[CS^{Aut}(k) - CS^{Aut}(0)]. \end{aligned} \tag{3.17}$$

It is reasonable to assume that $CS^{Aut}(k) > CS^{Aut}(0)$, if an innovation implies lower production costs, or higher quality products and if, at the same time, competition increases as a new firm enters the product market competition. Turning to the integrated mar-

[10] We have abstracted from coordination problems in the formation of a lobbying group. Taking this into account it is possible that the total amount of lobbying contributions from incumbents increase, if the number of incumbent firms is reduced, even if aggregate profit decreases.

ket, a symmetric argument gives that the policy maker's objective function in integrated markets (3.8) becomes:

$$\begin{aligned}\max_{\tau} G(\tau) &= \tau z_E^{win}(\tau) + W_I^{Int}(\tau) + W_E^{Int}(\tau) - \bar{\Omega}_I^{Int} - \bar{\Omega}_E^{Int} \\ &+\alpha \left\{ CS^{Int}(0) + z^{entry}(\tau)[CS^{Int}(k) - CS^{Int}(0)] \right\},\end{aligned} \tag{3.18}$$

where we once more assume that $CS^{Int}(k) > CS^{Int}(0) > 0$. We can now examine how entry barriers are affected by integration. Solving (3.17) and (3.18), we obtain:

$$\begin{aligned}\tilde{\tau}^{Aut} - \tilde{\tau}^{Int} &= \underbrace{\left[\Pi_I^{Aut}(0) - \Pi_I^{Aut}(k)\right]}_{(+)} - \underbrace{\tilde{\lambda}_I}_{(0.1)} \underbrace{\left[\Pi_I^{Int}(0) - \Pi_I^{Int}(k)\right]}_{(+)} + \underbrace{\tilde{\lambda}_E}_{(-)} \Pi_E^{Int}(k) \\ &-\alpha\{\underbrace{CS^{Aut}(k) - CS^{Aut}(0)}_{(+)} - \underbrace{\tilde{\lambda}_I}_{\in(0,1)} \underbrace{[CS^{Int}(k) - CS^{Int}(0)]}_{(+)}\}.\end{aligned} \tag{3.19}$$

The first line in (3.19) is once more conducive to lower entry barriers when going from autarchy to integration, However, ambiguities arise from the second line in (3.19). Moreover, it is plausible that the difference $CS^{Aut}(k) - CS^{Aut}(0)$ is larger than $CS^{Int}(k) - CS^{Int}(0)$, since both the effect of an innovation and of an additional firm increasing competition is larger in the autarchy market. This leads to the following proposition:

Proposition 4. *A higher weight α on consumer surplus will tend to reduce the difference $\tilde{\tau}^{Aut} - \tilde{\tau}^{Int}$, if $CS^{Aut}(k) - CS^{Aut}(0) > CS^{Int}(k) - CS^{Int}(0)$, thereby making the effect of integration on the entrepreneurial fee weaker.*

In the Cournot model with linear demand and symmetric countries, it is verified that $CS^m(k) > CS^m(0)$ from the increase in output due to the cost-reducing innovation and the entry of an additional firm. Moreover, it also shown that $\left[CS^{Aut}(k) - CS^{Aut}(0)\right] > \left[CS^{Int}(k) - CS^{Int}(0)\right]$ since the entry of an innovative entrepreneurial firm is more important in the autarchy economy where the initial output is lower.

Corollary 1. *Assuming that the number of firms is unchanged by integration, the linear*

Cournot model introduced in Section 3.5 yields:

$$\left[CS^{Aut}(k) - CS^{Aut}(0)\right] > \left[CS^{Int}(k) - CS^{Int}(0)\right].$$

Proof. In the Appendix. ■

4. Extensions

In this section, we consider two extensions. First, we allow for a global incumbent lobbying group that can simultaneously give contributions to the domestic and the foreign policy maker. We then study the case of entrepreneurial innovation for sale.

4.1. Global incumbent lobbying

Now, relax the assumption that incumbents can only lobby their domestic policy maker. Instead, assume that incumbent firms come together as one global lobbying group, giving contributions to both the domestic and the foreign policy maker. Entrepreneurs are, as previously, restricted to only lobby against their own policy maker, and the policy maker once more takes the other policy maker's fee as exogenous.

For each pair of policies (τ, τ^*), the incumbent lobbyist is willing to pay a total contribution of L_I^{Global}. This contribution is split between the domestic and the foreign policy maker: $L_I + L_I^* = L_I^{Global}$. Extending the framework of truthful bids, introduced in section (2.4), raises the issue of policy complementarity. The reason is that a global lobbying group will take the change in policy of one government into account when lobbying against the other, even though governments are assumed not interact directly. In technical terms, the amount the lobbying group must compensate one government (Cf. eq.2.7) is decreased by a term representing the reduction in compensation that the group must give to the policy maker in the other country. This yields the possibility of asymmetric equilibria where all lobbying effort is concentrated to one government. In the extreme case, a global lobby succeeds in driving the probability of innovation in one country to zero, effectively leaving the other country in a situation similar to autarchy.

To get around this problem, and be able to retain the notion of truthful bids, we make the assumption that the lobbying group sends a delegate to each country. The two delegates are each equipped with a schedule of what lobbying contributions they are allowed to give the policy maker for any entrepreneurship policy in that country. The two delegates are not allowed to communicate once the lobbying game has started, so that the lobbying offered for a policy in one country is independent of the offer to the other country. When devising the delegates' schedules, the lobbying organization considers:

$$\left(\tau_I^{opt}, \tau_I^{*opt}\right) \in \arg\max_{\tau,\tau^*} W_I^{Global}(\tau, \tau^*) - C(\tau) - C^*(\tau^*), \tag{4.1}$$

where $W_I^{Global}(\tau, \tau^*)$ is the expected income of the global incumbent lobbying group. Moreover, due to the assumptions of no communication and the absence of policy interaction, we have:

$$C(\tau) = G_{-inc}^{Int}(\tau_{-inc}^{opt}) - G_{-inc}^{Int}(\tau) \tag{4.2}$$

$$C^*(\tau^*) = G_{-inc}^{*Int}(\tau_{-inc}^{*opt}) - G_{-inc}^{*Int}(\tau^*). \tag{4.3}$$

Given a pair $\left(\tau_I^{opt}, \tau_I^{*opt}\right)$, we can restrict the set of lobbying contributions to truthful ones and state the lobbying function as:

$$\begin{aligned} L_I^{Tot}(\tau, \tau^*) &= W_I^{Global}(\tau, \tau^*) - \left[W_I^{Global}(\tau_I^{opt}, \tau_I^{*opt}) - C(\tau_I^{opt}) - C(\tau_I^{*opt})\right] \qquad (4.4) \\ &= W_I^{Global}(\tau, \tau^*) - \bar{\Omega}_I^{Global}. \end{aligned}$$

It remains to show how much of the total lobbying contribution that is spent on the domestic and the foreign policy maker, respectively. Incumbents' expected revenues are a function of profits and the probability that one of the entrepreneurs is successful, $z^{entry}(\tau, \tau^*) = 1 - [1 - z(\tau, \tau^*)]\,[1 - z^*(\tau, \tau^*)]$. This implies that incumbents' revenues are maximized for fees such that $z(\tau, \tau^*) = z^*(\tau, \tau^*)$. Due to symmetry, this requires that $\tau = \tau^*$. However, the allocation is also dependent on the compensation functions $C(\tau)$ and $C^*(\tau^*)$, which are more involved in the general case. If these are convex functions with $C_\tau(\tau), C_{\tau\tau}(\tau) > 0$ and $C^*_{\tau^*}(\tau), C^*_{\tau^*\tau^*}(\tau) > 0$, the costs are, once more due to symmetry, minimized when $\tau = \tau^*$. We can show this to hold in our parametric example in Section 3.5. If the optimal fees for the incumbent lobbying group are such that the policy makers set $\tau = \tau^*$, this yields, by symmetry, that the lobbying contribution is split in two equal halves. Lobbying contributions from the incumbent lobbying group to the domestic policy maker can, in other words, be written as:

$$L_I(\tau, \tau^*) = 0.5 L_I^{Global}(\tau, \tau^*) = 0.5 W_I^{Global}(\tau, \tau^*) - 0.5 \bar{\Omega}_I^{Global}. \tag{4.5}$$

Now consider the entrepreneur. Due to the presence of a global incumbent lobbying group, the compensation that the entrepreneur will have to give the policy maker in order to deviate from its optimal policy, absent the entrepreneur, will look different. However, it will only change the benchmark optimal revenues (net of lobbying contributions). The lobbying contribution from the entrepreneur is thus the same as in (2.9), with only the constant $\bar{\Omega}_h^{Int}$ being different.

Hence, the only difference from the case where the incumbent firms were only allowed to lobby against the policy maker in their own country is the multiple 0.5 in front of the incumbents' expected revenues. In the case of symmetric countries, it is easily realized that the problem, and the optimal fee, are the same in both cases.

Proposition 5. *If policy makers take the other country's fee as given, and countries are symmetric, then under the assumption of no communication between delegates, the optimal fee in integrated markets is not changed when incumbent firms are allowed to lobby against both policy makers.*

Corollary 2. *We show that in the parametric model in Section 3.5, the optimal fees for the incumbent lobbying group are such that $\tau = \tau^*$.*

Proof. In the Appendix. ■

4.2. Entrepreneurial innovations for sale

In the analysis, we have assumed that entrepreneurs enter the market. In practice, we observe that entrepreneurs often sell their innovation. Indeed, we observe a significant amount of inter-firm technology transfers, ranging from joint ventures and licensing to outright acquisitions of innovations.[11] The venture capital industry provides some evidence of the relation between innovation for sale and innovation for entry. Figure II depicts the quarterly value of exits through M&As and IPOs, respectively, in the US in the stage 1999 to 2005. Note that M&As dominate as the exit mode, except at the beginning of the stage.

—— [FIGURE II] ——

However, it can be shown that our identified mechanism is still valid as long as there is bidding competition over the innovation. The reason is that the entrepreneur then exerts similar negative externalities as in case of entry, and globalization affects these externalities in a similar fashion. To see this, assume that all n incumbents are homogeneous and consider the following sale model: If a sale takes place, the entrepreneur sells its innovation (firm) through a first price perfect information auction with externalities. The acquisition auction is solved for Nash equilibria in undominated pure strategies. There is a smallest amount, ε, chosen such that all inequalities are preserved if ε is added or subtracted.

In autarchy, the n incumbents simultaneously post bids, which are accepted or rejected by the entrepreneur. In the case of the closed economy, only domestic incumbents bid and in the case of the integrated economy, both domestic and foreign incumbents bid. Each incumbent announces a bid, b_i, where $b = (b_1, ..., b_i, ...b_n) \in R^n$ is the vector of

[11] Granstrand and Sjölander (1990) present evidence from Sweden, and Hall, Berndt and Levin (1990) present evidence from the US of firms acquiring innovative targets to gain access to their technologies. Bloningen and Taylor (2000) find evidence from US high-tech industries of firms making a strategic choice between the acquisition of outside innovators and in-house R&D. In the biotech industry, Lerner and Merges (1998) note that acquisitions are important for know-how transfers.

these bids. Following the announcement of b, the innovation is sold to the incumbent with the highest bid ($b_i = S_E$). If more than one incumbent has the highest bid, each such incumbent obtains the innovation with equal probability. In the integrated market, there are $n + n^*$ incumbents bidding.

Instead of separating the incumbents' and the entrepreneur's product market profits, we must now distinguish between the profit of an acquiring and a non-acquiring incumbent firm. Denote the former $\pi_A^m(k)$ and the latter $\pi_N^m(k) < \pi_A^m(k)$ for $m = Aut, Int$. Given this, we can write an incumbent's valuation of obtaining the innovation as:[12]

$$v^m = \pi_A^m(k) - \pi_N^m(k), \;\; m = Aut, Int. \tag{4.6}$$

From this it is straightforward that:

Lemma 3. *The equilibrium sale price is* $S_E = v^m$.

In a symmetric model without exits $\Pi_I^m(k) = \pi_A^m(k) - v^m + (n-1)\pi_N^m(k) = n\pi_N^m(k)$ and $\Pi_I^m(0) = n\pi_N^m(0)$ and hence, $\Pi^m(0) > \Pi_I^m(k)$. Thus, from Lemma 3 it follows that the previous results carry over to the case of sale.[13] We can thus state the following result:

Proposition 6. *In the case with innovation for sale with a sufficiently large number of symmetric incumbents, the optimal entrepreneurial policy* τ *will be more pro-entrepreneurial when the product and innovation markets integrate internationally, i.e.* $\tau^{Aut} - \tau^{Int} > 0$.

Consequently, since innovations are, by definition, unique assets and bidding competition then seems natural, our identified result also seems relevant for the case of entrepreneurs selling their innovation.

5. Econometric Analysis

The prediction emerging from Proposition 1 suggests that globalization in terms of the integration of markets should reduce the domestic entry barriers for entrepreneurs. As

[12] If the quality of the innovation k is low there is also an entry deterring valuation for incumbents. However, for a sufficiently high quality k it can be shown that we need only consider (4.6)

[13] Calculations for the post oligopoly case are available from the authors upon request.

shown by Proposition 4, this effect may also be stronger in countries where governments are to a larger extent rent extracting. Moreover, by Proposition 2, we expect entry barriers to be lower when neighboring countries are more pro-entrepreneurial. To test these predictions, we now turn to an empirical analysis of how barriers to entry are affected by a country's international openness. Descriptive statistics for all variables involved are put in appendix Table A.1.

5.1. Econometric Model

To examine Proposition 1, we will estimate a reduced-form model of how the international openness of a country affects the cost of entry for domestic entrepreneurs. For country i, at time t, we have:

$$Entry\_cost_{i,t} = \alpha_0 + \underset{(-)}{\alpha_1} Globalization_{i,t} + \mathbf{X}'_{i,t}\boldsymbol{\beta} + \gamma_i + \gamma_t + \varepsilon_{i,t}, \tag{5.1}$$

where $Entry\_\mathrm{cost}_{i,t}$ is the entry cost, $Globalization_{i,t}$ is proxied by measures of globalization, $X_{i,t}$ is a vector of controls, γ_i is a country-specific effect, γ_t a time-specific effect and u_{ij} is the usual error term. From Proposition 1, the entry barriers should be negatively correlated with measures of globalization, $\alpha_1 < 0$. We discuss all variables affecting entry barriers, the choice of proxies and the data in the sections below. Descriptive statistics are presented in the Appendix, Table A1.

To examine Proposition 4, we will augment (5.1) and compare the impact of globalization in countries with high and low corruption where rent-seeking governments should be associated with a higher level of corruption:

$$\begin{aligned} Entry\_cost_{i,t} \;=\;& \alpha_0 + \underset{(-)}{\alpha_1} Globalization_{i,t} + \underset{(+)}{\alpha_2} Corruption_{i,t} + \\ & \underset{(-)}{\alpha_3} Corruption_{i,t} \times Globalization_{i,t} + \mathbf{X}'_{i,t}\boldsymbol{\beta} + \gamma_i + \gamma_t + \varepsilon_{i,t}. \end{aligned} \tag{5.2}$$

As shown by Proposition 4, we would expect countries associated with a higher level of corruption to have higher entry barriers, but also to be more strongly affected by globalization, $\alpha_2 > 0$ and $\alpha_3 < 0$. The argument is that governments in countries with a high level of corruption are less likely to care about consumer welfare.

Our approach of establishing a correlation running *from globalization to entry barriers* differs from the previous literature which has used entrepreneurial polices acting as an explanatory variable. Table A.2 provides an overview. For instance, the level of entry barriers has been found to be a very good predictor of the level of corruption (Svensson 2005). Entry barriers have been discussed as a factor determining how apt a country is at using trade liberalization to generate growth (Freund and Bolaky, 2008; Fisman and Sarria-Allende, 2004). In addition, entry barriers have been found to have a strong negative effect on sector-level productivity and dynamics (Klapper *et al.*, 2006; Barseghyan, 2008). As compared to (5.1) and (5.2), previous studies have used entry costs as an explanatory variable. While our approach is novel, this generates a concern for endogeneity and reverse causality.[14] We try to deal with this in a number of ways.

First, we include country-specific effects and use the time variation in entry barriers, whereas previous studies have used data for one year, frequently the data for 1999 used in Djankov *et al.* (2002). Second, we try to exploit the exogenous variation in globalization using the expansion of the EU in 2004 to a number of Eastern European countries to identify the effect of globalization on entry barriers. Third, we will try to control for an omitted variable in the form of a general country-specific trend in institutional quality.

5.1.1. Dependent variable: Entry barriers

To proxy the cost τ levied on entrepreneurial entry, we will use data from the World Bank's *Doing Business* project. The World Bank's *Doing Business* project was initiated by Djankov *et al.* (2002), and collects country-level data on the cost of setting up a limited liability company.[15] Djankov *et al.* (2002) collected data for entry barriers for

[14] Measures of openness may be endogenous if a reduction in entry barriers leads to the entry of export-oriented firms affecting measures of openness as suggested by the recent trade literature of heterogenous firms (see, for instance, Helpman, Melitz and Rubinstein, 2008). In the literature on corruption, there is also an established link between entry barriers and the level of corruption (see Svensson, 2005).

[15] The same project also collects data on other dimensions of barriers to entry: the number of procedures and the time it takes to start a new company and the capital requirement. The reason why we focus on the cost measure is that this is the most direct and most readily interpreted aspect.

a sample of 85 countries in 1999. The extension of this project has collected data for approximately 120 countries since 2003. The most recent wave in the survey is for 2007. The entry costs include official fees and fees for the legal or professional services needed to fulfil the procedures required by law. The aim is to net out unofficial costs due to corruption and costs pertaining to bureaucratic inefficiencies. To control for differences in the level of development, the cost for setting up a new business is scaled by country per capita income. To adjust for the skewness in the distribution, we will take the log of entry costs.

5.1.2. Explanatory variable: International market integration

We use two indices to measure the international integration of product and innovation markets. As a first measure, we use the kof index provided by the Swiss Federal Institute of Technology in Zurich. Our second measure is the *csgr index* provided by University of Warwick.[16] Data for the csgr index is available from 1999 to 2004 and data for the kof index is available for the period 1999-2005. Both indices cover more than 120 countries. Figure III shows a strong negative correlation between the kof globalization index and the entry costs, giving some initial support for Proposition 1.

—— [FIGURE III] ——

The two indices build on partly overlapping sources and are constructed by similar methods capturing economic, social and political aspects of globalization. The main components of the economic parts are trade flows and in- and outflows of direct and portfolio investments. The social parts build on information on international personal contacts and information flows. Political globalization is measured by membership in international organizations and participation in UN missions. The main difference between the two indices pertains to the weighting procedures.[17] The indices are described in detail in

[16] Examples of previous studies using these indices include Dreher (2006) and Joyce (2006).

[17] Other differences are due to classification. This mainly concerns how remittances by foreign nationals are classified. In the kof index, these are part of economic globalization whereas the csgr index considers these as part of social globalization. Another difference is that the kof index includes a measure for cultural proximity (proxied as the presence of multinational firms such as McDonald's and Ikea) as part of social globalization.

appendix Table A.3.

The globalization that we have theoretically depicted contains the integration of both product and innovation markets. How these relate to our empirical measures of economic, social as well as political aspects is not straightforward. The *foreign innovation threat* and the *strategic innovation effort* effects identified in (3.10) imply a negative correlation between entry barriers and international integration. Arguably, these two effects are closer to political integration such as participation in international organizations. Countries that enforce international patent rights are more likely to see the profits of domestic incumbents being pushed down by the entry of foreign innovative firms. To some extent, a higher degree of social integration paves the way for foreign entrants in a similar manner. Conversely, it is plausible that entry on foreign markets is facilitated for innovators originating from countries that are highly politically and socially integrated.

However, Proposition 1 predicted a negative correlation between entry barriers and international integration conditional on some properties of incumbents' profits. Empirically, it is likely that economic integration, entailing a reduction in the barriers that a company meets when selling on a foreign market, will affect incumbents' profits. However, social as well as political integration also affect the de facto barriers faced by a company when expanding its business abroad.

To the best of our knowledge, there exists no established methodology in the literature on how to separate product and innovation market integration. In view of this, our main explanatory variable will be the aggregate index, although we also present the results for each sub index separately.

5.1.3. Other covariates

The cross-country effect of openness $Open_{i,t}$ on entry barriers $Entry\_cost_{i,t}$ in (5.1) is likely to be confounded with a range of variables. Among these, the income level and the features of the overall institutional setup (formal-legislative as well as their implementation) stand out as the most serious ones. In our main specification, we therefore control for country-specific effects, γ_i. This mitigates the concerns with income level and other institutions.

The main omitted variable problem that remains concerns changes in institutions over the time period studied. Formal institutions may affect both the level of globalization and the barriers to entry. Implementation and enforcement of institutions, reflected in government efficiency and the prevalence of corruption, and income level are hard to control for since these are likely to be endogenously affected by entry barriers. However, we argue that endogeneity may be less of a concern with respect to formal institutions. There is less reason to believe that formal institutions, as put down in a country's legislation, are influenced by legislation specifically pertaining to entry barriers.

To control for the omitted variable problem, we construct a measure intended to capture the extent to which a country's legislation is aligned to free-market valuations. This index is constructed as the principal component of those parts of the Heritage Foundation index that are collected from legal documents.[18]

When examining Proposition 4 by estimating (5.2), we also include a measure of corruption as an interaction variable with openness. The index is the so-called KKM (Kaufmann, Kraay and Mastruzzi, 2007) available from the World Bank.

5.2. Results

We first run different specifications of the model in eq 5.1. As shown in the first column of Table I, openness is highly correlated with entry barriers across countries. The effect is also large, one standard deviation decrease in the kof-index amounts to nearly a doubling of the entry costs, and the effect of the csgr index is similar. Adding a control for other institutions in column (ii), the effects of openness are decreased but still highly significant. The magnitudes of the effect of the control for institutions and entry barriers are roughly equal. Adding year dummies in (iii) does not change these results. Controlling for continent in (iv) and (v) reduces the effects, in particular for the csgr index. The estimated coefficients for openness are still significant at conventional levels, however.

The effects are also robust to the inclusion of country-specific effects in (vi). A decrease

[18]These are: trade freedom (tariffs), fiscal freedom (tax levels), government size (government expenditures), financial freedom (regulation of banks) and protection of property rights.

in openness equal to one standard deviation increases the cost of entry by some 55 (kof) and 60 (csgr) percent. Adding both country and time effects reduces the estimate for the kof index below conventional significance levels. The estimates for the csgr index are still significant, the effect of a one standard deviation change in the index amounts to a change in costs in the order of 35 percent.

—— [TABLE I] ——

Table II breaks down the indices into their subcomponents in cross-country regressions. All three aspects of openness tend to have a negative effect on entry barriers. The strongest and most significant effects are found for social integration. The estimates for economic openness are weaker, however. In fact, as shown in columns (iv), the independent effect of economic openness, when controlling for social and political integration, tends to have a positive effect on entry costs.

In this interpretation, the weak results for economic integration presented in Table II are consistent with the ambiguous theoretical prediction in Proposition 1 of whether the incumbent's losses from innovation increase with trade liberalization. The stronger results for a negative effect on entry fees from political and social integration are consistent with an interpretation where these dimensions more closely reflect that globalization reduces the fee due to *foreign innovation threat* and *strategic innovation effort* effects.

—— [TABLE II] ——

Rent seeking governments Proposition 4 shows that globalization in terms of increased openness should have a stronger effect on the entry barriers erected by governments with stronger preferences for rent-shifting. To investigate Proposition 4, we employ interaction effects between openness and corruption. To alleviate the concerns of endogeneity, we construct dummy variables for corruption levels above the mean. Figure IV clearly shows that the correlation between openness and barriers to entry is much stronger in the high-corrupt subsample. The regression results are reported in Table III. The interaction effects in columns (ii) come out as highly significant with both corruption indices. Consistent with Proposition 4, countries that score higher on the corruption index are those with the largest negative effect on the cost of entry from being more open. The results are similar for the csgr and the kof index. In the latter case, the interaction term dominates the main effect of openness, whereas openness still has a significant main effect with the csgr index.

——— [FIGURE IV] ———

——— [TABLE III] ———

Policy complements Proposition 2 shows that the entrepreneurial policies set by governments in different countries are strategic complements. The domestic policy maker will be induced to reduce the barriers to entry if neighboring countries set more pro-entrepreneurial policies. One way of testing this proposition is to construct an average neighbor for each country. This is done by, for each country, summing the distance-weighted entry barriers in all other countries in the sample. The results from this exercise are reported in Table IV. Column (i) reports the results without country-specific effects and without a time trend. The coefficient on the distance-weighted neighbors' cost of entry is positive – indicating that countries with more entrepreneurial friendly governments also have lower barriers to entry – and strongly significant. This result is robust to adding a time trend in column (ii), and country-specific effects in column (iii). When we add both country-specific effects and a time trend in column (iv), the estimates only remain significant for specifications using the kof index.

——— [TABLE IV] ———

5.3. Difference-in-difference

To estimate the effects of a greater openness on entry barriers, we also employ an alternative strategy. As an exogenous shock to openness, we use entry into the European Union. In the 2004 enlargement, 10 countries entered as new members of the EU. The selection of new EU members was exogenous in the sense that only countries belonging to a specific geographical region are eligible to apply for membership.

Membership forced these countries to integrate their product and innovation markets into the EU single market. However, one institutional feature that to a large extent escaped the harmonization process was entry barriers as long as they were not discriminatory.[19] Moreover, it should be noted that although entry barriers are substantially lower in EU countries than in other countries in the sample, there is substantial heterogeneity among EU countries.[20] This reduces the concern that new members were subject to informal pressure from other members to reduce their barriers to entry. Hence, we argue that any variation in barriers to entry subsequent to entering the EU is likely to be due to a changed benefit from protection for incumbents vis-à-vis entrepreneurial firms.

Using countries that were members of the EU throughout the period 2000–2007, we can use a difference-in-difference design to isolate the effect of entry into EU on entry barriers. Figure V shows the trend lines for entry barriers for new EU members, old EU members and all other countries. The new EU members clearly show a kink around 2004, after which they reduced their entry barriers almost to the same level as the mean for old members.

—— [FIGURE V] ——

[19] The Treaty of Lisbon has one paragraph where the promotion of small- and medium sized companies is mentioned (§157). However, the wording is much vaguer than in the paragraphs stipulating commitment to free movement of trade and services (§§23-31).

[20] EU countries had an average cost of starting a new business of approximately 10 percent of GDP per capita. The same number is around 30 percent for the whole sample (excluding sub-Sahara Africa). However, whereas countries such as Denmark, Sweden, Finland and the UK had a cost of approximately 1 percent, Spain had 16 percent, Italy 18 percent and Greece 28 percent. The numbers reported above are averages over all observed years.

—— [TABLE V] ——

The decrease in cost of entry also clearly emerges from the regression results shown in Table V where the estimate for new members is negative and significant. The average cost of entry among the new membership was 30 percent lower in the period 2004–2007 than in 2000–2003.

5.4. Robustness

Considering the heterogeneity in our country sample, it might be suspected that the observed effect of openness on entry barriers pertains to some sub-sample or is driven by outliers. The first two columns of Table VI show estimates for a sample where the income bottom or top 20-percentile of the sample has been dropped. If anything, this tends to strengthen the results. Next, some countries that have been subjected to aid programs have been forced to comply with some institutional improvement program. One concern is that this creates a spurious relation between entry costs and openness for some countries. As a robustness check, we exclude sub-Saharan countries from our sample in column (iii).

Next, our data on entry costs is collected both from the 1999 Djankov *et al.* (2002) sample and from the more recent extension of the survey. There might be some concerns about changes in the measurement driving our result. In column (iv), we exclude observations from the older sample, which reduces both the size and the significance of the effects. The results for the csgr index still pass significance tests at conventional levels and are substantial in magnitude. As a final robustness check in column (v), we exclude some countries where extreme variation makes us concerned about measurement error.

—— [TABLE VI] ——

6. Conclusion

Industrial policy worldwide has shifted the attention towards small and entrepreneurial firms. Our analysis explains this as an endogenous response to the ongoing international integration of product and innovation markets. In more open economies, it becomes more difficult to protect the profits of incumbent firms from independent innovators, and innovation efforts become more intertwined across countries, thus making foreign entrepreneurs more aggressive. This reduces the incumbents' incentive to pay for protection against the domestic entrepreneur, hence reducing the entry barriers. The data supports our theory by indicating a strong negative correlation between openness and the degree of barriers to entry into entrepreneurship.

We also find that the reduction of barriers to entry into entrepreneurship is larger in more corrupt countries. Consequently, the ongoing process of international agreement on trade and investment such as WTO agreements (e.g. TRIPS), and the enlargement of the EU single market program might be of particular benefit for entrepreneurs and consumers in the most corrupt countries.

In our analysis, we also identify the effects of international market integration that could make policies more anti-entrepreneurial. If international market integration is accompanied by merger and exit waves, incumbents' profits may increase to such an extent that their willingness to pay to protect their market increases to such an extent that policies can become more anti-entrepreneurial. Consequently, if entrepreneurial activity is considered to have positive externalities on societies in general, policies preventing the internationally integrated markets from becoming too concentrated seem warranted. Internationally active and coordinated merger and anti-predatory policies then seem to be natural ways of achieving this.

What other factors could explain the recent trend towards pro-entrepreneurial policies? One potential explanation is the increased importance of international policy benchmarking. The inception of new indices, such as, e.g., the *Doing Business* index, is likely to make governments more prone to evaluate their policy relative to other countries. Theoretically, we can incorporate this effect by showing that entrepreneurship policies are indeed strategic complements when governments interact. We also find empirical evidence that one country's entrepreneurship policy is influenced by the policies of neighboring countries.

The existing entrepreneurship literature has typically explained the shift towards more pro-entrepreneurial policies as a consequence of the increased advantage of small scale activities and technological development favoring small scale production (Achs and Audretsch, 2005; Loveman and Sengenberger, 1991; Baumol, 2002). These explanations do not contradict our explanation, but rather interact with our political economy explanation. Exploring this interaction in detail is left to future research.

Let us end by using our framework to briefly shed some light on the world welfare effects of product and innovation market integration when entrepreneurial innovations are present. Starting with the effects on consumers, we note that when markets become integrated, they will benefit from lower consumer prices for two reasons. First, if no innovation takes place, product competition will be tougher, thus reducing consumer prices. Second, it is more likely that consumers can benefit from the use of a successful innovation since also the foreign innovation will be used in their market. The size of these effects will then depend on how much total effort spending by the entrepreneurs is affected by integration and changes in policy. Moreover, the total producer surplus might increase or decrease because competition is increased both in the product market and in the innovation market, while more efficient technology will be used and the duplication cost will be reduced. A more detailed study of this is left to future research.

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TABLE I
MAIN RESULTS, EFFECTS ON COST OF ENTRY FROM OPENNESS

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
Panel 1: Openness measured by the kof-index							
Openness	-4.67 (0.24)***	-2.99 (0.36)***	-2.99 (0.36)***	-2.02 (0.37)***	-1.98 (0.36)***	-2.60 (1.03)***	-0.28 (1.16)
Institutions		-0.29 (0.05)***	-0.30 (0.05)***	-0.29 (0.05)***	-0.301 (0.05)***	-0.02 (0.06)	-0.05 (0.06)
Region effects	No	No	No	Yes	Yes	No	No
Year effects	No	No	Yes	No	Yes	No	Yes
Country effects	No	No	No	No	No	Yes	Yes
Obs	533	523	523	523	523	523	523
R2	0.44	0.46	0.47	0.25	0.27	0.04	0.25
Panel 2: Openness measured by the csgr-index							
Openness	-4.24 (0.27)***	-2.56 (0.36)***	-2.50 (0.37)***	-1.15 (0.42)***	-1.02 (0.42)**	-3.39 (0.61)***	-1.58 (0.737)**
Institutions		-0.34 (0.05)***	-0.35 (0.05)***	-0.36 (0.06)***	-0.38 (0.06)***	0.01 (0.08)	-0.09 (0.08)
Region effects	No	No	No	Yes	Yes	No	No
Year effects	No	No	Yes	No	Yes	No	Yes
Country effects	No	No	No	No	No	Yes	Yes
Obs	363	360	360	360	360	360	360
R2	0.42	0.48	0.49	0.22	0.24	0.13	0.21

Robust standard errors reported in parentheses. *** indicates p-value<0.01, ** p-value<0.05 and * p-value<0.1. Region effects are continent-specific effects: East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, North America, South Asia, Sub-Saharan Africa.

TABLE II
RESULTS BROKEN DOWN BY SUBCOMPONENT OF GLOBALIZATION INDEX

	kof-index				csgr-index			
	(i)	(ii)	(iii)	(iv)	(i)	(ii)	(iii)	(iv)
Economic openness	-0.78 (0.35)**			0.44 (0.34)	-1.81 (1.14)			2.86 (1.00)***
Social openness		-3.96 (0.41)***		-4.47 (0.50)***		-3.81 (0.40)***		-4.33 (0.54)***
Political openness			-1.15 (0.022)***	-0.72 (0.20)***			-1.55 (0.32)***	-0.75 (0.31)***
Institutions	-0.57 (0.04)***	-0.19 (0.06)***	-0.57 (0.03)***	-0.11 (0.06)*	-0.61 (0.04)***	-0.21 (0.05)***	-0.55 (0.04)***	-0.12 (0.05)**
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	524	566	567	523	384	416	456	360
R2	0.42	0.51	0.46	0.52	0.43	0.53	0.46	0.54

Regressions do not include country-specific effects. Robust standard errors reported in parentheses. *** indicates p-value<0.01, ** p-value<0.05 and * p-value<0.1.

TABLE III
INTERACTION BETWEEN OPENNESS AND LEVEL OF CORRUPTION

	kof-index		csgr-index	
	(i)	(ii)	(i)	(ii)
Openness	-2.61 (0.37)***	-0.58 (0.55)	-2.12 (0.38)***	-1.47 (0.52)***
High corruption	0.74 (0.14)***	2.47 (0.36)***	0.58 (0.18)***	-1.23 (0.29)***
Interaction Openness*High corruption	-	-3.18 (0.65)***	-	-2.43 (0.88)***
Institutions	-0.16 (0.06)***	-0.26 (0.06)***	-0.24 (0.06)***	-0.31 (0.07)***
Year effects	Yes	Yes	Yes	Yes
Country Effects	No	No	No	No
Obs	523	523	360	360
R2	0.50	0.52	0.50	0.51

Regressions without country-specific effects. Robust standard errors reported in parentheses. *** indicates p-value<0.01, ** p-value<0.05 and * p-value<0.1.

Table IV
Policy Complements.

	(i)	(ii)	(iii)	(iv)
Panel 1: Openness measured by the kof-index				
Openness	-3.25 (0.34)***	-3.23 (0.34)***	-0.93 (1.12)	-0.25 (1.14)
Distance-Weighted Neighbours' Cost of entry	1.15 (0.18)***	1.09 (0.19)***	2.81 (0.40)***	1.10 (0.44)**
Institutions	-0.33 (0.05) ***	0.33 (0.05)***	0.04 (0.06)	-0.02 (0.06)
Year effects	No	Yes	No	Yes
Country effects	No	No	Yes	Yes
Obs	517	517	517	517
R2	0.48	0.49	0.00	0.01
Panel 2: Openness measured by the csgr-index				
Openness	-2.54 (0.35)***	-2.49 (0.35)***	-2.43 (0.69)***	-1.56 (0.65)**
Distance-Weighted Neighbours' Cost of entry	1.29 (0.27)***	1.27 (0.27)***	2.17 (0.61)***	0.08 (0.99)
Institutions	-0.41 (0.05)***	-0.42 (0.05)***	0.01 (0.09)	-0.06 (0.08)
Year effects	No	Yes	No	Yes
Country effects	No	No	Yes	Yes
Obs	355	355	355	355
R2	0.50	0.50	0.20	0.43

Robust standard errors reported in parentheses. *** indicates p-value<0.01, ** p-value<0.05 and * p-value<0.1.

TABLE V

DIFFERENCE-IN-DIFFERENCE RESULTS FOR NEW EU-MEMBERS

	(i)	(ii)
EU member	-0.77 (0.18)***	-0.33 (0.17)**
Institutions	-0.05 (0.06)	-0.07 (0.05)
Year Dummies	No	Yes
Obs	797	797
R2	0.21	0.18

Regressions include country-specific effects. Identification on countries that switch from being outside the EU to becoming members in 2004. Robust standard errors are reported in parentheses.

TABLE VI

ROBUSTNESS CHECKS

	(i)	(ii)	(iii)	(iv)	(v)
Panel 1: Openness measured by the kof-index					
Openness	-3.85 (0.74)***	-3.04 (1.14)***	-2.34 (1.11)***	-1.88 (1.38)	-1.81 (1.02)*
Institutions	0.001 (0.06)	0.02 (0.07)	-0.01 (0.06)	0.02 (0.05)	0.002 (0.05)
Year effects	No	No	No	No	No
Country effects	Yes	Yes	Yes	Yes	Yes
Obs	408	448	428	383	475
R2	0.12	0.05	0.03	0.03	0.02
Panel 2: Openness measured by the csgr-index					
Openness	-3.26 (0.59)***	-3.83 (0.63)***	-3.91 (0.63)***	-1.30 (0.47)***	-3.68 (0.62)***
Institutions	0.01 (0.09)	0.01 (0.09)	-0.03 (0.07)	0.16 (0.11)	0.05 (0.06)
Year effects	No	No	No	No	No
Country effects	Yes	Yes	Yes	Yes	Yes
Obs	268	326	309	236	325
R2	0.13	0.16	0.19	0.04	0.21

Regressions include country-specific effects. Robust standard errors reported in parentheses. *** indicates p-value<0.01, ** p-value<0.05 and * p-value<0.1. The following observations have been dropped: column (i) the top 20-percentile in income/capita; (ii) the bottom 20-percentile; (iii) sub-Sahara countries; (iv) observations before 2002: and (v) countries with extreme variation (Ghana, Indonesia, Uganda, Zimbabwe, Jordan, Mexico, Nigeria, Zambia and Dominican Republic).

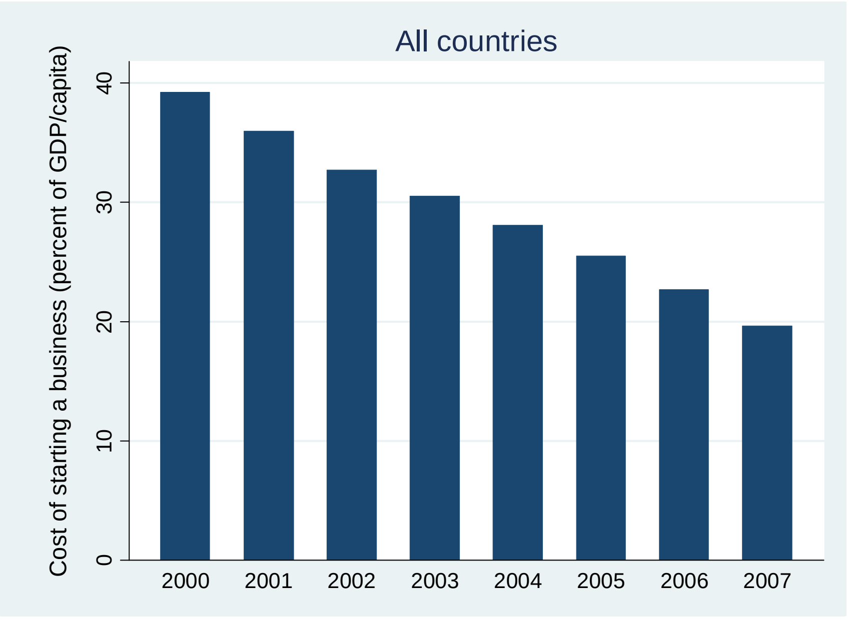

FIGURE I, PANEL A
Average Cost of Starting a New Business 2000 –2007 Among 72 Countries.

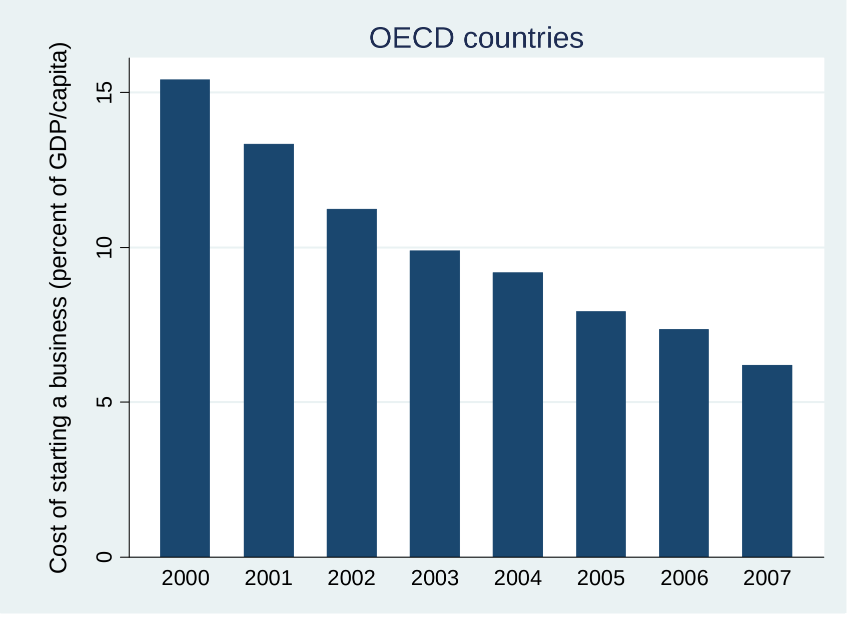

FIGURE I, PANEL B
Average Cost of Starting a New Business 2000 –2007 Among OECD Countries.

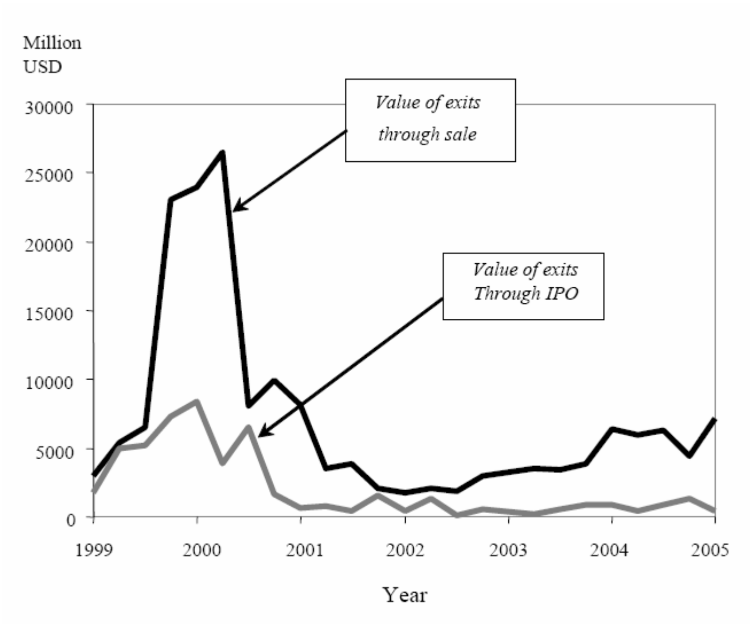

FIGURE II
The value of exits through M&A and IPO in the US.
Source: Thomson Venture Economics/National Venture Capital Association.

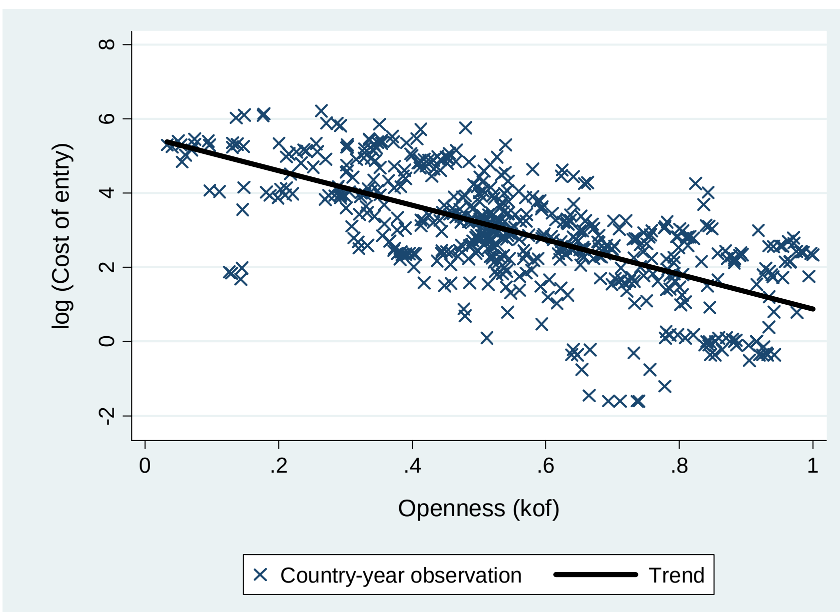

FIGURE III
Correlation Between Openness and Barriers to Entry.

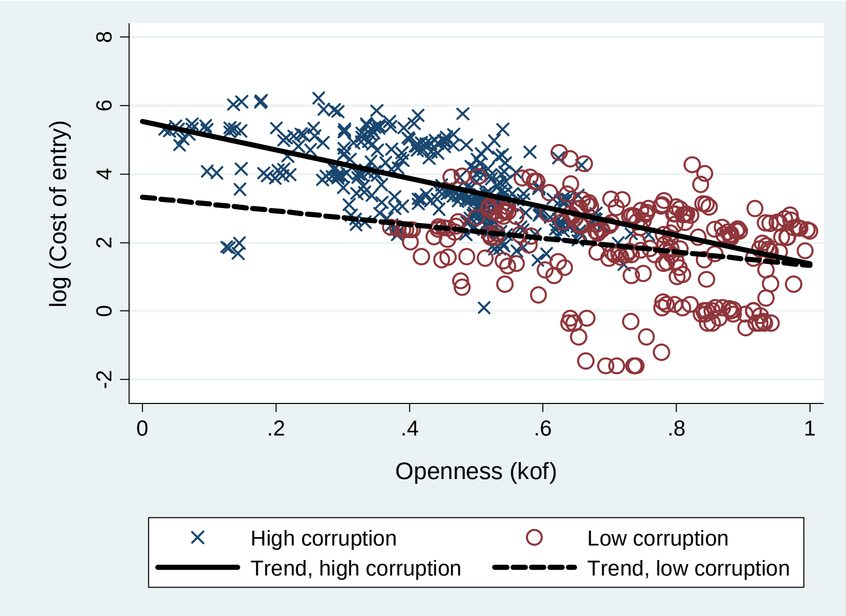

FIGURE IV
Correlation Between Openness and Barriers to Entry by Level of Corruption.

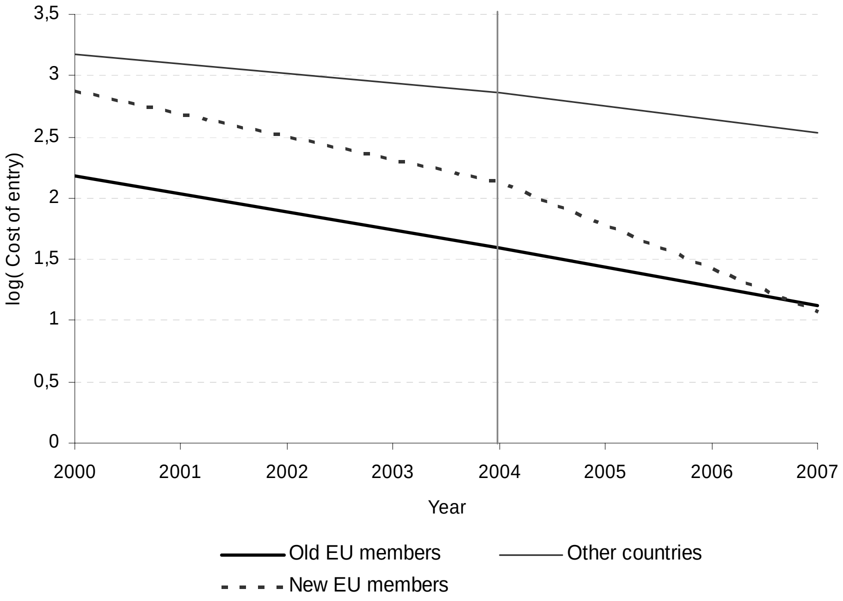

FIGURE V
Barriers to Entry Among New EU Members.

Appendix

Lemma 1

Take logs of the domestic and foreign policy makers' FOCs:

$$\begin{aligned}\log z'_e + \log(1-0.5z^*) - \log y'_e &= -\log\left[\pi_E^{Int}(k) - F - \tau\right] \\ \log z'_{e^*} + \log(1-0.5z^*) - \log y'_{e^*} &= -\log\left[\pi_E^{Int}(k) - F - \bar{\tau}^*\right].\end{aligned}$$

Differentiate. First note that

$$\frac{de^*}{de} = \left[\frac{0.5z'_e}{(1-0.5z)}\right] / \left[\frac{z''_{e^*e^*}}{z'_{e^*}} - \frac{y''_{e^*e^*}}{y'_{e^*}}\right] < 0.$$

Then write in matrix form

$$\begin{bmatrix} \frac{z''_{ee}}{z'_e} - \frac{y''_{ee}}{y'_e} & -\frac{0.5z'^*_{e^*}}{(1-0.5z^*)} \\ -\frac{0.5z'_e}{(1-0.5z)} & \frac{z''_{e^*e^*}}{z'_{e^*}} - \frac{y''_{e^*e^*}}{y'_{e^*}} \end{bmatrix} \begin{bmatrix} \frac{de}{d\tau} \\ \frac{de^*}{d\tau} \end{bmatrix} = \begin{bmatrix} \frac{1}{\left[\pi_E^{Int}(k)-F-\tau\right]} \\ 0 \end{bmatrix}. \tag{1}$$

Under the assumption of stability, $0 > \frac{de^*}{de} > -1$, we have that the determinant D is positive. Therefore

$$\begin{bmatrix} \frac{de}{d\tau} \\ \frac{de^*}{d\tau} \end{bmatrix} = \frac{1}{D} \begin{bmatrix} \left[\frac{z''_{e^*e^*}}{z'_{e^*}} - \frac{y''_{e^*e^*}}{y'_{e^*}}\right]\left[\frac{1}{\left[\pi_E^{Int}(k)-F-\tau\right]}\right] \\ \left[\frac{0.5z'_e}{(1-0.5z)}\right]\left[\frac{1}{\left[\pi_E^{Int}(k)-F-\tau\right]}\right] \end{bmatrix},$$

so that $\frac{de}{d\tau} < 0$ and $\frac{de^*}{d\tau} > 0$. Therefore, we have

$$\begin{aligned} z'_\tau &= \frac{dz}{de}\frac{de}{d\tau} < 0 \\ z^{*\prime}_\tau &= \frac{dz}{de^*}\frac{de^*}{d\tau} > 0. \end{aligned}$$

Lemma 2

Given the profits in (3.13), we study

$$\frac{\left[\Pi_I^{Aut}(0) - \Pi_I^{Int}(0)\right]}{\left[\Pi_I^{Aut}(k) - \Pi_I^{Int}(k)\right]} = \frac{(\Lambda)^2}{(\Lambda-k)^2}\left(\frac{(n+1)^{-2} - 2(2n+1)^{-2}}{(n+2)^{-2} - 2(2n+2)^{-2}}\right). \tag{2}$$

We have that

$$\frac{(\Lambda)^2}{(\Lambda-k)^2} > 1$$

and

$$(n+1)^{-2} - 2(2n+1)^{-2} > (n+2)^{-2} - 2(2n+2)^{-2}, \text{ for } n > 1$$

thus

$$\left[\Pi_I^{Aut}(0) - \Pi_I^{Int}(0)\right] > \left[\Pi_I^{Aut}(k) - \Pi_I^{Int}(k)\right].$$

Proposition 2

Assume probabilities on the form $z(e) = 1 - \exp(-\gamma e^2)$ and effort cost according to δe^2. The first-order conditions in (3.4) and (3.5) can then be written as:

$$\begin{aligned}(1-z)(2-z^*) &= \delta\left[2\gamma(\pi-\tau)\right]^{-1} \\ (1-z^*)(2-z) &= \delta\left[2(\pi-\tau^*)\gamma\right]^{-1}.\end{aligned}$$

Taking logs, differentiating and writing in matrix form we have:

$$\begin{bmatrix} -\frac{z'}{1-z} & -\frac{z^{*\prime}}{2-z^*} \\ -\frac{z'}{2-z} & -\frac{z^{*\prime}}{1-z^*} \end{bmatrix} \begin{bmatrix} \frac{de}{d\tau} \\ \frac{de^*}{d\tau} \end{bmatrix} = \begin{bmatrix} \frac{1}{\pi-\tau} \\ 0 \end{bmatrix}.$$

With a determinant $D > 0$, so that:

$$\begin{bmatrix} \frac{de}{d\tau} \\ \frac{de^*}{d\tau} \end{bmatrix} = \frac{1}{D} \begin{bmatrix} -\frac{z^{*\prime}}{1-z^*} & \frac{z^{*\prime}}{2-z^*} \\ \frac{z'}{2-z} & -\frac{z'}{1-z} \end{bmatrix} \begin{bmatrix} \frac{1}{\pi-\tau} \\ 0 \end{bmatrix}.$$

We thus have

$$\frac{de}{d\tau} / \frac{de^*}{d\tau} = \left[-\frac{z^{*\prime}}{1-z^*}\right] / \left[\frac{z'}{2-z}\right],$$

and

$$\frac{dz}{d\tau} / \frac{dz^*}{d\tau} = \left[\frac{z'}{z^{*\prime}}\right]\left[\frac{de}{d\tau} / \frac{de^*}{d\tau}\right] = -\frac{2-z}{1-z^*}.$$

Using this to rewrite the FOC of the policy maker in integrated markets (3.10) yields:

$$\begin{aligned}\tau^{Int} &= \left[\Pi_I^{Int}(0) - \Pi_I^{Int}(k)\right]\left[\frac{(1-z^*)}{(1-0.5z^*)(2-z)}\right] \\ &\quad -\Pi_E^{Int}(k)\frac{(1-z^*)}{(2-z)}\frac{0.5z}{(1-0.5z^*)}.\end{aligned}$$

Differentiate with respect to foreign policy τ^* and rearrange to get

$$\begin{aligned}
&\frac{d\tau}{d\tau^*} + z_\tau^{*\prime} \frac{d\tau}{d\tau^*} \left[\Pi_I^{Int}(0) - \Pi_I^{Int}(k)\right] \left[\frac{2}{(2-z^*)(2-z)} + \frac{2}{(2-z^*)^2(2-z)}\right] \\
&+ z_\tau^{*\prime} \frac{d\tau}{d\tau^*} \Pi_E^{Int}(k) \left[\frac{2}{(2-z)(2-z^*)} + \frac{z}{(2-z^*)^2(2-z)}\right] \\
= \; & \left[\Pi_I^{Int}(0) - \Pi_I^{Int}(k)\right] \left[z_{\tau^*}^{\prime} \left[\frac{2\,(1-z^*)}{(2-z^*)(2-z)^2} + \frac{2}{(1-z)\,(2-z^*)(2-z)}\right]\right] \\
&+ \Pi_E^{Int}(k) \left[z_{\tau^*}^{\prime} \left[\frac{2\,(1-z^*)}{(2-z^*)(2-z)^2} + \frac{1}{(1-z)\,(2-z^*)} \frac{z}{(2-z)}\right]\right].
\end{aligned}$$

Solving for $\frac{d\tau}{d\tau^*}$ and diving through yields (noting that $z_\tau^{*\prime}, z_{\tau^*}^{\prime} > 0$):

$$\frac{d\tau}{d\tau^*} > 0.$$

Proposition 3

We have

$$\begin{aligned}
\tau^{Aut} - \tau^{Int} = \; & \left[\Pi_I^{Aut}(0) - \Pi_I^{Aut}(k)\right] + \\
& \left[\frac{(1-z^*)}{(1-0.5z^*)(2-z)}\right] \left[0.5z\Pi_E^{Int}(k) + \Pi_I^{Int}(k) - \Pi_I^{Int}(0)\right]
\end{aligned}$$

With profits given by (3.13). We note that

$$\frac{d}{dn}\left[\Pi_I^{Aut}(0) - \Pi_I^{Aut}(k)\right] < 0$$

and

$$\left[\Pi_I^{Aut}(0) - \Pi_I^{Aut}(k)\right] \to 0 \text{ as } n \to \infty.$$

Assume that n is large so that

$$\tau^{Aut} - \tau^{Int} \approx \left[\frac{(1-z^*)}{(1-0.5z^*)(2-z)}\right] \left[0.5z\Pi_E^{Int}(k) + \Pi_I^{Int}(k) - \Pi_I^{Int}(0)\right]$$

To prove existence of an m such that $\tau^{Aut} - \tau^{Int} < 0$ we then need to show that

$$\left[0.5z\Pi_E^{Int}(k) + \Pi_I^{Int}(k) - \Pi_I^{Int}(0)\right] < 0$$

This inequality will hold if the number of firms in the integrated market m is small and the quality of the innovation is k is sufficiently small. More specifically, assume $m = 1$ and $z = 1$ which gives:

$$\begin{aligned} & \left[0.5z\Pi_E^{Int}(k) + \Pi_I^{Int}(k) - \Pi_I^{Int}(0)\right] \\ = \; & \frac{1}{2}\left(\tfrac{\Lambda+2k}{3}\right)^2 + \left(\tfrac{\Lambda-k}{3}\right)^2 - \left(\tfrac{\Lambda}{2}\right)^2 < 0, \end{aligned}$$

where the inequality holds provided that $k < \frac{1}{2}\Lambda$.

Corollary 1

First, note that the LC model yields the following expressions for consumer welfare

$$\begin{aligned} CS^{Aut}(0) &= 0.5Nn^2(n+1)^{-2}(\Lambda)^2 \\ CS^{Aut}(k) &= 0.5N(n+2)^{-2}(\Lambda + k + An - cn)^2 \\ CS^{Int}(0) &= 0.5Nn^2(2n+1)^{-2}(2\Lambda)^2 \\ CS^{Int}(k) &= 0.5N(2n+2)^{-2}(\Lambda + k + 2n\Lambda)^2. \end{aligned}$$

Next, consider the change in consumer surplus

$$\begin{aligned} & \left[CS^{Aut}(k) - CS^{Aut}(0)\right] - \left[CS^{Int}(k) - CS^{Int}(0)\right] \\ = \; & -\left[CS^{Aut}(0) - CS^{Int}(0)\right] + \left[CS^{Aut}(k) - CS^{Int}(k)\right]. \end{aligned}$$

First note that if we set $k = 0$, meaning that an entrepreneur enters with an ineffective innovation, we still have that

$$-\left[CS^{Aut}(0) - CS^{Int}(0)\right] + \left[CS^{Aut}(k) - CS^{Int}(k)\right] > 0,$$

since the entry of a new firm is more important in autarchy, where the initial number of firms is small. Then, show that the difference is increasing in k:

$$\frac{d\left[CS^{Aut}(k) - CS^{Int}(k)\right]}{dk} > 0,$$

with the intuition that the increase in output due to the innovation is more important in the autarchy market with a smaller number of firms.

Corollary 2

To find its optimal lobbying schemes, the global incumbent lobbying group solves the following problem

$$\max_{\tau,\tau^*} W(\tau,\tau^*) - C(\tau) - C^*(\tau^*),$$

where $C(\tau)$ and $C^*(\tau^*)$ are given by (4.2) and (4.3). Using the parametric model, and combining the two first-order conditions, we obtain:

$$\frac{\tau}{\tau^*} = \frac{(1-z^*)}{(1-z)} \frac{2\left[\Pi_I(0) - \Pi_I(k)\right] + z(\pi_E(k) - F)}{2\left[\Pi_I(0) - \Pi_I(k)\right] + z^*(\pi^*_E(k) - F)}, \tag{3}$$

where $\Pi_I(0)$ and $\Pi_I(k)$ are the aggregate profit of domestic and foreign incumbent firms absent and with entrepreneurial entry, respectively. Now, assume that $\tau > \tau^*$, then (by symmetry) $z < z^*$. This leads to a contradiction since the RHS of (3) is < 1, whereas the LHS is > 1. Symmetrical reasoning leads to a contradiction if $\tau < \tau^*$. Hence, to satisfy the first-order condition, we must have that $\tau = \tau^*$.

TABLE A.I
SUMMARY STATISTICS

	Year	Observations	Mean	Std.dev	Min	Max
log(cost)	2000-2008	889	2.973	1.610	-2.302	7.163
log(cost)	2000-2005	541	3.083	1.523	-1.743	7.163
log(cost)	2000-2004	431	3.084	1.504	-1.743	7.163
kof	2000-2005	642	0.584	0.166	0.184	0.934
kof economic	2000-2005	756	0.634	0.197	0.119	1.000
kof social	2000-2005	847	0.522	0.216	0.106	0.954
kof political	2000-2005	854	0.564	0.261	0.078	0.990
csgr	2000-2004	444	0.363	0.225	0.080	1.000
csgr economic	2000-2004	584	0.154	0.082	0.062	1.000
csgr social	2000-2004	630	0.163	0.195	0.000	0.985
csgr political	2000-2004	732	0.373	0.199	0.098	0.948
Institution	2000-2005	706	-0.018	1.620	-3.470	4.253
Institution	2000-2004	588	-0.015	1.608	-3.351	4.253
Distance-Weighted Neighbours' Cost of entry	2000-2008	968	0.487	0.252	0.119	1.808

TABLE A.2

STUDIES USING THE WORLD BANK'S DOING BUSINESS INDEX.

	Dependent	Entry Barrier	Method	Result
Djankov et. al., (2002)	Corruption	Cost, procedures and time	Cross-country regressions (N=78) controlling for gdp/capita.	Positive effect (more corruption) in countries with higher entry barriers.
Svensson (2005)	Corruption	Procedures	Cross-country regressions (N=60) controlling for gdp/capita and education.	Positive effect (more corruption) in countries with many procedures.
Fisman and Sarria-Allende (2004)	Number, average size and operating margin of firms per 3-digit sector.	Cost	Interaction of sector specific natural entry barrier and growth potential with country specific entry barrier due to regulation.	In industries with low natural entry barriers, the average size of firms depends positively, and number of firms negatively, on the entry cost imposed by regulation.
Chang, Kaltani and Loayza (2005)	Growth	Index of cost, procedures and time	Panel of 80 countries over 40 years (5-year avg). Study interaction of openness with (time-invariant) institutional variables.	Openness has a positive effect on growth only in countries with low entry barriers.
Barseghyan (2008)	Output per worker and TFP	Cost	Cross-country IV regressions (N=50-100), with instruments for entry costs. Also controlling for human capital, corruption and business regulation (other than entry costs).	Negative effect of entry costs on output per worker and TFP.
Freund and Bolaky (2008)	Income gdp/capita	Procedures	Cross-country regressions (N=100-126) studying interaction of openness with entry regulation.	Finds strong negative effect of entry regulation and its interaction with openness on gdp/capita.
Klapper, Laeven and Rajan (2006)	Firm creation, average size of entrants and growth of incumbents	Procedures and entry	Interaction of country specific (institutional) entry barriers with industry specific characteristics (natural entry barriers)	Higher institutional entry barriers lower entry rate in sectors with high natural entry barriers, leads to larger new entrants, and increase incumbents' value added per employee.

TABLE A.3

GLOBALIZATION INDICES AND THEIR SUBCOMPONENTS

	CSGR index		KOF index	
	Variable	Weight	Variable	Weight
Economic	Exports plus imports of goods and services as a proportion of GDP	0.418	Trade (percent of GDP)	0.19
	Inflows plus outflows of foreign direct investment as a proportion of GDP	0.092	Foreign Direct Investment, flows (percent of GDP)	0.20
	Inflows plus outflows of portfolio investments as a proportion of GDP	0.220	Foreign Direct Investment, stocks (percent of GDP)	0.23
	Employee compensation paid to non-resident workers and investment income from foreign assets owned by domestic residents plus employee compensation paid to resident workers working abroad and investment income from domestic assets owned by foreign residents, as a proportion of GDP.	0.270	Portfolio Investment (percent of GDP)	0.17
			Income Payments to Foreign Nationals (percent of GDP)	0.09
			Hidden Import Barriers	0.01
			Mean Tariff Rate	0.09
			Taxes on International Trade (percent of current revenue)	0.07
			Capital Account Restrictions	0.09
Social	Stock of foreign population as proportion of total population.	0.088	Telephone Traffic	0.09
	Inflows of foreign population as proportion of total population.	0.208	Transfers (percent of GDP)	0.01
	Worker remittances (receipts) as a proportion of GDP.	0.026	International Tourism	0.09
	Number of tourists (arrivals plus departures) as proportion of total population.	0.009	Foreign Population (percent of total population)	0.07
	International outgoing telephone traffic (minutes) per capita	0.003	International letters (per capita)	0.09
	Internet users as a percentage of population	0.203	Internet Users (per 1000 people)	0.12
	Number of films imported and exported.	0.041	Television (per 1000 people)	0.12
	Sum of value of books and newspapers imported and exported per capita (US dollars)	0.386	Trade in Newspapers (percent of GDP)	0.10
	Number of international letters delivered and sent per capita	0.036	Number of McDonald's Restaurants (per capita)	0.12
			Number of Ikea (per capita)	0.12
			Trade in books (percent of GDP)	0.08
Political	Number of foreign embassies in country	0.378	Embassies in Country	0.25
	Number of UN peacekeeping operations in which country participates	0.357	Membership in International Organizations	0.28
	Number of memberships of International organisations	0.266	Participation in U.N. Security Council Missions	0.22
			International Treaties	0.25

Note that the weight refers to weight in each sub-index. For further information about sources for the specific variables we refer to (csgr) http://www2.warwick.ac.uk/fac/soc/csgr/index/ and (kof) http://globalization.kof.ethz.ch/. I both cases variables are normalized across time and countries. The weights are obtained as the principal component of the variables in each subindex. The kof index obtains the overall globalization index as the principal component of the three sub-indices, whereas the overall csgr index is the average (with equal weights) of the three sub-indices. In our estimations we exclude the following parts of the kof index: hidden import barriers, mean tariff rate, taxes on international trade and capital account restrictions. The index we use is obtained as the principal component excluding this variables

Essay V

Entrepreneurship and Second-best Institutions: Going Beyond Baumol's Typology*

Robin Douhan[1,2] and Magnus Henrekson[1]

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Abstract

This paper reconsiders the predominant typology pioneered by Baumol (1990) among productive, unproductive and destructive entrepreneurship. It is shown that the foundation of Baumol's classificatory scheme is the restrictive concept of first-best outcomes, and therefore it easily fails to appreciate the true impact of entrepreneurship in real world circumstances characterized by suboptimal institutions. We present an alternative way of generalizing the notion of entrepreneurship and show how and why it encompasses the Baumol typology as a special case. Our main distinction is between business and institutional entrepreneurship. We draw on Schumpeter and introduce the entrepreneur in an additional function: as a potential disturber of an *institutional* equilibrium. Various subsets of institutional entrepreneurship are posited and discussed. It is shown that changing the workings of institutions constitutes an important set of entrepreneurial profit opportunities. An implication of this is that entrepreneurial efforts to reform or offset inefficient institutions can in many cases be welfare-improving.

JEL: L5, M13, O31, O17

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[1]Research Institute of Industrial Economics (IFN)
e-mail: magnus.henrekson@ifn.se

[2]Department of Economics
Uppsala University

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1 Introduction

Just two decades ago the received view was that economic growth is caused by the accumulation of factors of production. In his seminal contributions Douglass North (e.g., 1990) claimed that this is merely a proximate cause of growth, the ultimate causes residing instead in the incentive structure that encourages individual effort and investment in physical and human capital and in new technology. This incentive structure is in turn determined by "the rules of the game in society" or the institutional setup. The role of institutions has in recent years re-emerged as a dominant mainstream explanation of long-term economic performance (e.g., Rodrik *et al*., 2004, and Acemoglu *et al*., 2005).

William Baumol (1990) pioneered in examining the role of institutions for entrepreneurial behavior and analyzing how "the social structure of payoffs" channeled entrepreneurial talent to different activities, which may be productive, unproductive or destructive. He assumed the supply of entrepreneurial talent to be roughly constant, and thus that the rate of growth is largely determined by its distribution across the three types of entrepreneurship, which is in turn determined by the institutional setup.

Baumol's (1990) typology dividing entrepreneurial activities into productive, unproductive and destructive forms has proven to be an intuitive and appealing way of expanding the set of activities that require entrepreneurial talent (see, e.g., Minniti, 2008). It has played an invaluable role in highlighting the role of institutions and accelerated our understanding of the growth and welfare effects of entrepreneurial activity. Recently, the typology has been especially influential as research has sought to dig deeper into the particularities of unproductive and destructive entrepreneurship. It is therefore important to examine more closely the assumptions on which his theory rests.

Baumol (1990) focuses primarily on institutions as an allocation device. However, analyzing institutions solely as allocation devices overlooks the fact that *the institutional framework within which an activity is performed often determines whether this activity is productive, unproductive or destructive.* In particular, what looks like an unproductive activity may in many circumstances be a second-best substitute for inefficient institutions.

Provision of second-best substitutes is an important instance of a more general set of phenomena in which entrepreneurial activities *change the workings of the institutional setup*. This partly obfuscates the role of institutions as an allocation mechanism by creating an analytical circularity. How can the structure of rewards that allocates talent itself be determined by the application of this talent? One way out of this dilemma is to acknowledge that institutions become targets for entrepreneurial innovativeness because *changing their workings is a means of earning or enhancing entrepreneurial profit*.

There is a strong possibility of earning profit by changing the way formal institutions affect other agents, particularly when current institutions are costly for productive activities. By relaxing institutional restrictions on productive entrepreneurship, these efforts may be welfare-improving even though they are driven mainly by individuals' incentives to earn profit.

We build on this insight to extend the concept of entrepreneurship in a novel way, going beyond purely business related activities. Like Baumol's typology, our proposal goes back to Schumpeter (1934). In contrast to Baumol who defines the entrepreneurial function exclusively in terms of Schumpeter's notion of entrepreneurship as innovative combinations, we assign the additional function of disturbing an equilibrium to the entrepreneur.

We propose a typology consisting of business entrepreneurship and institutional entrepreneurship. The allocation between these types is determined by potential rewards embedded in the existing institutional setup and in the production system. The two types of entrepreneurship disturb, respectively, the production system and the institutional equilibrium. An activity that disturbs the institutional equilibrium could be a novel welfare-improving second-best substitute for inefficient institutions, but may also reduce welfare. Baumol's typology is shown to fit nicely into our new proposal as a special case where the welfare consequences of the activity at hand are known *ex ante*.

The next section outlines the most important features of Baumol (1990) and how the literature has evolved. Section 3 sheds light on some subtle limitations of Baumol's typology and the preconditions for its application. In section 4 we make a case for our own contribution and discuss how it extends Baumol's theory. The concluding section offers a summary and looks forward to further work.

2 Baumol's Typology

Baumol's analysis represents an essential step in bringing institutions to the fore of the analysis of the role of entrepreneurship in economic development. By referring to basic microeconomic assumptions it is hypothesized that core entrepreneurial talents – such as creativity, alertness and ability to get things done – are used to maximize individual utility, not social welfare. It then follows that entrepreneurship is not necessarily welfare enhancing.

Baumol's analysis rests on two premises. First, he assumes entrepreneurial talent is reasonably equally distributed across time and societies, but that its manifestation crucially depends on the institutional setup.[1] Second, he follows Schumpeter and defines the entrepreneurial function as the carrying out of new combinations. Baumol (1990, p. 897) presents his theory as an extension of Schumpeter's five types of combinations:[2]

> To derive more substantive results from an analysis of the allocation of entrepreneurial resources, it is necessary to expand Schumpeter's list, whose main deficiency seems to be that it does not go far enough […] Schumpeter's list of entrepreneurial activities can usefully be expanded to include such items as innovations in rent-seeking procedures, for example, discovery of a previously unused legal gambit that is effective in diverting rents to those who are first in exploiting it.

Based on this extension, Baumol builds a typology of productive, unproductive and destructive entrepreneurship. The classification of activities into one of these three types depends on several criteria: Do they increase overall productivity? Do they entail a redistribution that leaves overall productivity unaffected, or do they reduce it? Those who have referred to Baumol have often explicitly interpreted this as positive, zero and negative shifts of the production possibility frontier (e.g., Coyne and Leeson, 2004). What is noteworthy here is that, clearly, an activity cannot be properly assigned to one of the categories until its effect on productivity has been determined.

The strong conclusion that emerges from this analysis is that inefficient institutions not only forgo opportunities for social benefit by hampering productive entrepreneurship, but that they may as well direct entrepreneurial talent towards activities that reduce aggregate productivity and social welfare. This has naturally been seen as an important contribution to the literature on long-term growth (e.g., Hall and Jones, 1999; Jones, 2001). Micro-oriented studies have explored the

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[1] This idea was concurrently pursued with respect to managerial talent by Murphy, Shleifer and Vishny (1991).

[2] According to Schumpeter (1934, p. 66) entrepreneurial activities can consist of the: (i) introduction of a new good (or a new quality of a good); (ii) introduction of a new method of production; (iii) opening of a new market; (iv) conquest of a new source of supply of raw materials or semi-manufactured goods; and (v) implementation of a new organizational form.

implications of the allocation of talent (e.g., Acemoglu, 1995; Baumol, 1993, 2002). Recently, some interest has been focused on the particularities of the unproductive and destructive forms of entrepreneurship. For example, Desai and Acs (2007) sketch a theory that addresses occurrences of destructive entrepreneurship, and Coyne and Leeson (2004) and Smallbone and Welter (2002) apply the concepts in the context of a transition economy. Some progress towards empirical operationalization and assessment of the theory has also been made (Sobel, 2008).

Before turning to our central issue we want to draw attention to one of the core assumptions often overlooked when the Baumol typology is used. The problem is grasping the relevance of the unproductive category. In the proposed framework, entrepreneurial talent is viewed as a resource, and hence it is subject to scarcity of supply. Thus, even when entrepreneurial talent is channeled to unproductive activities that appear merely to entail a lump sum redistribution of resources, this necessarily must also involve an opportunity cost due to foregone productive potential. If unproductive activities are defined in terms of zero net effect on productivity, then this set of activities is very likely to be far too small to be of practical relevance. Henceforth, we simply amalgamate Baumol’s unproductive and destructive categories using the common label “non-productive”.

3 A Reconsideration of Baumol’s Typology

Although the main message of Baumol’s (1990) paper offers important insights into a range of issues, we still believe that fundamental aspects of the theory need closer scrutiny. By uncovering some preconditions for a proper application of the Baumol typology we also discuss some caveats that point towards our own contribution. In particular, it will be valuable to clearly recognize and elaborate on the inconsistency in treating institutions solely as an allocation mechanism. Before turning to this issue we must define our notion of efficiency.

Institutions in Baumol’s theory play the role of allocating entrepreneurial talent. He therefore (implicitly) defines inefficient institutions in terms of allocation into less productive categories. However, the welfare evaluation that necessarily predates assignment into the typology should be conducted against the backdrop of a more general notion of inefficiency. To unfold its essential aspects we will promulgate a highly stylized notion of efficiency. Productive activities, i.e., a market based provision of some (consumer) good or service, are simply assumed to be inherently efficient. Other, non-productive, activities are efficient or inefficient depending on whether they facilitate or hamper productive activities. Similarly, institutions are called efficient or inefficient depending on their positive or negative effect on productive activities.

It is important to realize that the different types of entrepreneurship all refer to a function, rather than an individual. The same individual could be engaged in both productive and non-productive activities at the same time. To see why this is relevant imagine a business owner who (in an innovative fashion) finds his way trough the bureaucracy red-tape and finally acquires a production license. This is wasteful because *given first-best institutions* this entrepreneur could have put his energy into productive activities. The same conclusion cannot be drawn *given the actual institutional setting* that the business owner faces. Given that setting, it is clear that the non-productive activity was a prerequisite for subsequent productive activities. This might hold even if the acquired license is a monopoly license, in which case the prevailing institutions are probably even less efficient. Even in this case, non-productive entrepreneurship may be a way of breaking a bureaucratic deadlock preventing the license from being handed out at all.[3]

More generally, activities which at first glance appear to be obvious examples of non-productive entrepreneurship routinely provide a second-best substitute for inefficient institutions. The two additional examples of corruption and the Mafia will further illustrate this point.

It is a long debated issue whether corruption greases inefficient institutions or puts sand in efficient (or inefficient) institutions (Méon and Sekkat, 2005). To be specific, inefficiency here refers to an overly bureaucratic governance structure and costs of red tape. Recent empirical studies show that the proposition that corruption reduces growth depends on the institutional setup. Méon and Weill (2008) and Klapper *et al*. (2006) find that the effect of inefficient institutions is smaller when the level of corruption is high.[4] Dreher and Gassebner (2007) found that corruption reduced the negative effect from inefficient institutions on entrepreneurial entry. These results indicate that in some cases it may be fruitful to view non-productive

[3] In addition to reducing the negative implications of unproductive entrepreneurship one can also hypothesize that there exists a positive effect from poorly functioning institutions. This could be the case where institutional barriers function as a gate-keeping mechanism, only letting the most talented entrepreneurs through. De Meza and Webb (1999), for instance, study a setting where banks have incomplete information about the ability of heterogeneous entrepreneurs. They show that under these assumptions too many agents of lower ability obtain funding. Hence, credit rationing may serve a gate-keeping function against low quality projects.

[4] Of course, arguments have also been put forward against the "greasing the wheels" hypothesis. See Dreher and Gassebner (2007) for references.

forms of entrepreneurship as a second-best *productive* response to suboptimal institutions.

Another example of entrepreneurship which at first sight belongs to the non-productive category is the Mafia. This is often mentioned as a prototypical example of violent extortion and appropriation of rents created by others. However, some scholars have argued that under unstable institutional circumstances, or poor enforcement of property rights, organized crime can actually provide a substitute. Bandiera (2003) discusses how the Sicilian Mafia thrived in a situation where the old feudal system was reformed and landholdings redistributed to the private sector without the concomitant creation of public institutions for law enforcement. In a similar vein, Milhaupt and West (2000) argue that organized crime in Japan is a natural response to inefficient institutions. Organized crime is, in their words, "an entrepreneurial response to inefficiencies in the property rights and enforcement framework supplied by the state" (*ibid.*, p. 43). Mafia activity in these Hobbesian situations might actually make the environment at least somewhat more predictable for the productive entrepreneur.

These examples have shown that the classification into productive, unproductive and destructive entrepreneurship is by no means straightforward, as Baumol himself recognizes in later writings (Baumol, 1993). The Baumol typology does not, and was never meant to, give any guidance on how to classify activities prior to making theoretical and empirical investigations. In particular, as the above examples show, possible second-best effects must be taken into account prior to classifying any activity.

The possibility that entrepreneurship provides second-best institutional solutions is interesting partly because of its significance in the real world, which is rife with imperfection and inefficiencies (Rodrik, 2008). For our purposes these activities also have an important theoretical implication. One cannot acknowledge that they, in effect, change the workings of formal institutions, but remain blind to the fact that they also change the social reward structure which in Baumol (1990) allocates entrepreneurial talent. Thus, without taking these effects into consideration, we cannot unambiguously determine how formal institutions will channel talent.

This problem never surfaces in Baumol (1990), because his purpose was to evaluate different institutional setups, *not* different entrepreneurial activities. Baumol's analysis was (implicitly) conducted against the backdrop of first-best institutions. It is noteworthy that Baumol (1990) discusses historical cases (Ancient Rome, China under the Sung Dynasty and England in the Late Middle Ages), in comparison to which modern Western institutions appear to be a reasonable proxy for first-best institutions. Hence, his analysis is consistent given its stated aim and the historical contexts he uses.

4 Institutional Entrepreneurship

This section presents an alternative way of extending the notion of entrepreneurship. We argue that this extended notion has several distinct advantages compared to the Baumol typology.

4.1 Entrepreneurial Opportunities

The possibility that non-productive entrepreneurship provides second-best solutions to institutional shortcomings points to a potential simultaneity problem where the structure of payoffs which determines the allocation of entrepreneurial effort is itself affected by the outcome of the allocation. This logical circularity can only be resolved by looking more closely at the mechanisms behind the allocation of talent.

In Baumol's (1990) theory the allocation mechanisms reside in the social reward structure, and there are no explicit feedback effects on the reward structure itself. To find fruitful ways out of this deadlock let us ask the following question: "What gives incentives to entrepreneurs to provide second-best solutions?" The obvious answer is the potential to exploit profit opportunities, or, as we will call them, rents. The perhaps less obvious insight offered by this answer is that the institutional setup itself provides ample entrepreneurial opportunities. We will call attempts to exploit such opportunities institutional entrepreneurship, in contrast to business entrepreneurship where profits emanate from innovations in the production system.

To highlight the similarity in objectives between the two types of entrepreneurship we will henceforth say that they are both driven by opportunities to earn rents (rather than profit). We define rents as rates of return exceeding the risk-adjusted market rate of return or return in excess of a resource owner's opportunity cost (Tollison, 1982). An alternative is to define rent as the part of the payment for a resource that has no effect on its supply (Alchian, 1987). However, in this definition it is implicitly assumed that rents exist exogenously, while entrepreneurship in our theory entails the creation and/or discovery of rents, thereby influencing the supply of entrepreneurship and other complementary factors of production.[5] In order to avoid potential confusion, we abstain from calling the entrepreneur a rent seeker. The reason is that our definition of this term, which is in line with how it is used in much of the entrepreneurship literature, differs from its use in public choice (e.g., Tullock, 1967; Buchanan, 1980).

Entrepreneurs can secure the kind of unique resources needed to generate rents in several ways. Obvious examples include patents on valuable innovations, copyright, skillful implementation of tacit knowledge that cannot be imitated, and other entrepreneurial innovations that require a resource unavailable to potential competitors.[6] In the broadest sense, the opportunities to earn a rent all involve the possession of some resource or technology which is unique or at least in very limited supply.[7] It is important to realize that there is in principle no difference in this respect between the possession of a patent and the possession of knowledge of how to best avoid costs imposed by the tax code, or the possession of highly valuable production knowledge and valuable personal connections enabling one's firm to circumvent cumbersome regulations even if this requires paying kickbacks to government officials.

In our view, *all entrepreneurial activities are directed towards the discovery or creation of opportunities to earn rent*s. Having said this, it is important to realize that the discovery or creation of opportunities to earn rents is not a sufficient condition for an activity to be classified as entrepreneurial. In the next section we will connect to the notion of Schumpeterian equilibrium disruption, thereby requiring an entrepreneurial activity to also be innovative and non-routine.

[5] See, e.g., Lewin and Phelan (2001), Alvarez (2007) and Henrekson (2007) for a discussion of entrepreneurial rents using the term as it is used here.

[6] Few rents last forever, and the durability varies substantially. Rents decay rapidly when they are based on activities that are easy to imitate and when the knowledge or skill is not embodied in a specific individual or organization. In such cases the rents are often called "Marshallian" or quasi-rents. Normally, imitating competitors enter the market, which increases the supply and lowers the price. Alternatively, the original entrepreneur cuts prices in order to deter entry. According to calculations by Nordhaus (2004), entrepreneurs retain on average a mere two percent of the surplus generated by their activities. Institutional entrepreneurs also face competition as other agents learn and adopt their methods of using institutions for their own benefit.

[7] We are only interested in rents earned by entrepreneurial – i.e., innovative – activity. One may argue that some resources which are not in limited supply, such as guns, are often used to appropriate rent through sheer force. However, in most instances such activities are not innovative, and therefore not entrepreneurial. And when an innovative activity requires the use of weapons (e.g., the Mafia), it is not the weapons in themselves that are unique, but the fashion in which they are put to use (e.g., in building the organization). This said, it is still true that many new military instruments have been innovative in themselves.

Moreover, it is a natural simplification to limit the analysis to such entrepreneurs that are primarily engaged in business activities. Thereby we exclude the forms of entrepreneurship where the agent has *de jure* decision power over institutions, often referred to as political entrepreneurship (e.g., Holcombe, 2002; Wohlgemuth, 2000).

4.2 Foundations Revisited

The distinction made above between different kinds of entrepreneurship was, in contrast to Baumol (1990), drawn without reference to Schumpeter's notion of new combinations. Before turning to more concrete examples it is advantageous to discuss how another aspect of Schumpeter's work may be useful in building a theory related to institutional entrepreneurship.

Modern entrepreneurship research draws mainly on two closely related aspects of Schumpeter (1934): The theory of new combinations and the theory of how the entrepreneur disturbs an existing equilibrium (the theory of creative destruction). The first theory describes what constitutes an innovation. In its most trivial (but clearly unfair) interpretation this is a mere list of examples of entrepreneurial activities. By assigning the role of disrupter of equilibrium to the entrepreneur, the theory of new combinations explains *how* this disruption is accomplished.

The usefulness of the theory of new combinations is indisputable, but we find it even more fruitful to dwell on the second aspect, the entrepreneur as a disturber of an existing equilibrium. Baumol (1990) built his typology on whether the innovation is a combination of productive or rent-seeking technologies. Our proposal is to separate different types of entrepreneurship based on *where* the entrepreneurial activity causes disruption. We extend the Schumpeterian notion of entrepreneurship to instances where the entrepreneur disrupts the institutional equilibrium. Following this reasoning institutional entrepreneurship[8] emerges as an important object of study in a theory that involves endogenous institutions (cf. Acemoglu, 2009).

One way to endogenize institutions is to consider a political economy growth system where different types of political power shape the institutional setup that will in its turn affect production processes (e.g., Acemoglu *et al*., 2005). An equilibrium can then be characterized in terms of the state of institutions as well as the state of

[8] The term "institutional entrepreneurship" has previously been used by Daokui, Feng and Jiang (2006) in a sense that resembles but is less general than ours.

the production system.[9] In relation to such an equilibrium we may talk about institutional or business entrepreneurship depending on where the disruption takes place (Douhan and Henrekson, 2008).

An alternative to considering changes to formal institutions within a full-blown political economy system is to distinguish between codified and effective institutions. Examples of codified institutions include written laws, constitutions and procedural rules governing agents in the bureaucracy. When taking the notion of institutions as rules that govern the behavior of agents seriously, what matters is in most cases not the formal versions of institutions but how they work in practice, i.e., how they are implemented and enforced. We will refer to these as *effective* institutions.[10]

In the next section we provide examples of how institutional entrepreneurship changes effective institutions. To see how that analysis differs from one building on a full-blown political economy system, consider the phenomenon of lobbying. In a modern society this is probably the most obvious example of how business interests try to influence the political sphere and formal institutions (Furlong and Kerwin, 2005).[11] Successful lobbying creates a rent when changes in codified institutions are translated into changes in effective institutions, for instance by granting a firm a monopoly position. Institutional entrepreneurship directed towards effective institutions, in contrast, creates the rent more directly, for instance by bribing a government official in order to earn special treatment that in effect gives the firm the same monopoly rights as when laid down in official documents.[12]

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[9] This could include informal institutions such as norms, value systems and codes of conduct, even though these are unlikely to have much relevance given the fact they are seldom, if ever, shaped by the acts of single agents.

[10] This is comparable to the alignment of governance structures with transactions taking place at level 2 of the institutional hierarchy in Williamson (2000). Alternatively, if we consider the effects in a full-blown political economy system it may be appropriate to see institutional entrepreneurship as taking place at level 3 (the institutional environment or the formal rules of the game).

[11] This type of entrepreneurship may be labeled political entrepreneurship and treated as a subgroup of institutional entrepreneurship. Political entrepreneurship does not *per se* require that the individual is engaged in commercial activities but refers primarily to innovativeness and motivation within the political sphere (Holcombe, 2002; Wohlgemuth, 2000). Our definition of entrepreneurship abstracts from this subset.

[12] Lambsdorff (2002) has questioned the validity of treating lobbying as equally wasteful as corruption. However, although the distinction made in this paper between the two types of institutional entrepreneurship comes close to the distinction between corruption and lobbying, it is different in that we draw the distinction primarily with respect to whether codified or effective institutions are altered. There is no contradiction involved in assuming that corruption is used to wield influence over codified institutions and lobbying is directed towards changing effective institutions.

4.3 Categories of Institutional Entrepreneurship

Institutions can have costly as well as beneficial effects on productive activities, i.e., they can be more or less efficient. In this section, to avoid confusion with more or less efficiently implemented institutions, we will use the words beneficial and costly institutions. Entrepreneurial opportunities reside in the reduction of the impact of costly institutions or the strengthening of the effects of beneficial institutions. In both cases rents can be earned by strengthening the position of a business entity (activity) owned by the same individual, in which case we may find it useful to talk about *evasive* entrepreneurship. Rents can also be earned from selling a service or contractual arrangement that reduces or strengthens the impact of a certain institution on another agent. We will focus our discussion on this latter kind of institutional entrepreneurship pertaining to market transactions.

One can imagine four basic ways of earning a rent by sale of a contract or a service to a third party: A, selling something that enhances the workings of beneficial, but poorly implemented, institutions; B, selling something that reduces the workings of harmful institutions; C, selling the withdrawal of a threat to strengthen harmful, but weakly implemented, institutions; D, selling the withdrawal of a threat to reduce the effect of beneficial institutions.[13] Note that there exist two extreme cases. First, where and when an institution is perfectly implemented, rents can only be earned by reducing (or threatening to reduce) its effectiveness. Second, where and when an institution is mere window dressing with negligible effect, rents can only be earned by increasing (or threatening to increase) its effectiveness. Our examples below relate to institutions which are in between these polar possibilities.

It is crucial to recognize that we do *not* claim that the activities of institutional entrepreneurs discussed below necessarily enhance social welfare. The words beneficial and harmful institutions refer rather to the effect that the institutions have on productive activities. Hence, our analysis is relevant to the micro level, i.e., the effect on individual productive agents. As illustrations of beneficial institutions we will consider the protection of private property rights and the possession of production licenses or other deeds that grant the holder a monopoly right. Concrete

[13] Institutions may arise as market outcomes when there is no formal governance. Formal institutions are important to mitigate market failures due to incomplete or asymmetric information and commitment and enforcement problems. A lack of public provision of such institutions provides ample opportunities for private agents to offer alternative solutions. This is neatly summarized by Dixit (2004, p. 97): "[E]very economic problem is an economic opportunity. Someone who can solve the problem, turning the potential gains into actual ones, may be able to charge a fee for this service." This is a special case of A.

examples of institutions that have potentially harmful effects on productive activities may include tax codes and ill-designed environmental legislation.[14]

A protective service provided by the Mafia is an example of the first kind of entrepreneurship (enhancing the workings of beneficial, but poorly implemented, institutions). As shown by Bandiera (2003) and Milhaupt and West (2000), such services can stabilize and make the environment of productive activities more predictable when the State is incapable of upholding law and order. The Mafia is then in possession of the unique resource of being able to provide protection of private property. The (informal) contract between the Mafia and the business provided with protection may to some extent be considered as an increased protection of property rights, yielding a rent to the Mafia.

Another example of the first kind of institutional entrepreneurship is when an agent manages to acquire some monopoly rights, i.e., a unique resource. This monopoly right can be sold or licensed to a productive agent in order for the latter to increase profit. The initial owner then receives a rent that accrues to his ability to identify the value of, and obtain, the monopoly right in the first place. Note that although an institutional setup that allows for monopoly licenses is likely to be inefficient from a social point of view, they are nonetheless still valuable for the individual productive agents.

Institutional entrepreneurship that reduces the effect of institutions harmful to the individual (but not necessarily to society) (B) is probably the most common. Tax consultants who come up with innovative ways of lawfully evading taxes is a good example. A parallel logic applies to innovative ways of adjusting productive activity so that the cost-increasing effects of environmental standards are mitigated. The unique resources in these cases consist of superior knowledge of how the rules laid down in the formal institutions can be sidestepped. Institutional entrepreneurship entails innovations such as finding loopholes or inconsistencies in the regulatory framework. Such knowledge may be used to avoid detection by enforcing agencies or to appeal to if prosecuted.

Examples of institutional entrepreneurship of type C (withdrawal of a threat to strengthen harmful, but weakly implemented, institutions) include litigation and systematic economic fraud. Numerous kinds of litigation may be viewed as invoking

[14] We only consider partial equilibrium effects in the sense that the firm does not take into consideration positive externalities of taxes (e.g., provision of educated labor and infrastructure) and environmental legislation (e.g., long-run positive effects of a conserved environment and a sustained supply of resources).

some legal paragraph according to which the subject is (at least potentially) punishable. Depending on the severity of the sanction, the subject is willing to pay the institutional entrepreneur in order to avoid the charge. Tax codes and environmental legislation can be mentioned as obvious examples of institutions that may be invoked, as well as the class action suits leveled against entire industries in the US (smoking, asbestosis). The kinds of innovations made by the institutional entrepreneur are similar to the ones mentioned under type B.

We mentioned some types of acquisition of production licenses as examples of type A. Seen from the perspective of the bureaucrat or the official in charge of production licenses there is also scope for entrepreneurship of type D (withdrawal of a threat to reduce the effect of beneficial institutions). This may occur when the bureaucrat threatens to withdraw a production or monopoly license. A firm possessing such licenses is in many cases willing to pay the bureaucrat in order to maintain their effectiveness. In highly corrupt countries, this type of threat may be part of the routine. Under other circumstances, entrepreneurial innovativeness is required to assess the value of the license and make the threat credible in a specific institutional setup.

The essential point of all these examples is that entrepreneurial activities should be evaluated against a well specified characterization of current conditions. The relevant context is the actual institutional setup, which in all contemporary and historical instances deviates from the first-best ideal. Hence, it is imperative to take into account the second-best effects. This certainly does not mean that institutional entrepreneurship is always welfare-improving from a social point of view. First, institutional entrepreneurship can and does in many cases impose an additional burden on the productive agent. Second, the net effect must include an objective assessment of which alternative productive activities the talent could instead have pursued.

To the extent that a welfare evaluation points to a negative welfare effect of institutional entrepreneurship, it is consistent to view it as instances of Baumol's non-productive types of entrepreneurship. Given that these are *ex ante* merely a subset of the universe of activities we call institutional entrepreneurship, our suggested classification is arguably more general.

Moreover, our emphasis on second-best substitutes does not preclude the kind of evaluations of institutions that Baumol (1990) conducted. First-best institutions are still a relevant benchmark for such evaluations. However, these should be compared with the effective institutions rather than the formal institutions, and therefore the role of the effect of institutional entrepreneurs must be taken into consideration.

Finally, it is worth emphasizing that the fact that an activity is conducted in search of a rent is not a sufficient condition for it to be labeled entrepreneurial. If bribery is part of routine business conduct, it is not an entrepreneurial activity, but rather an integral part of an established institutional equilibrium. Similarly, if every interest group repeatedly employs more or less identical lobbying tactics this is also part of an institutional equilibrium.

5 Concluding Remarks

William Baumol's classic 1990 *JPE* paper opened up a new research tradition at the nexus of entrepreneurship and institutions. We have argued that in order to take this field forward it is necessary to take a second look at some of the foundations of Baumol's theory. Our intention has not been to attack the conclusions of Baumol and his followers, but to provide a more general theory that escapes some of the problems inherent in the typology used.

In particular, we have stressed that it is difficult within the boundaries of the typology to account for entrepreneurial activities which are second-best substitutes for inefficient institutions. These activities are important because they can alter institutions in ways that make them more efficient. This observation has far-reaching consequences for how we evaluate the welfare consequences of entrepreneurial activities. In particular, it clearly reveals that a welfare evaluation based solely on a comparison with first-best institutions may be highly misleading. Second, the possibility that entrepreneurial activities are second-best substitutes for inefficient institutions necessitates a reconsideration of the role of institutions as an allocation device.

We argue that a distinction between business and institutional entrepreneurship is better able to capture allocation effects of institutions. What these diverse types of entrepreneurship have in common is that it makes perfect sense to regard them as a search for rents. There is no difference in principle between earning a rent (a rate of return exceeding the risk-adjusted market rate of return) through the possession of a patent or by virtue of superior knowledge of how to exploit institutions to one's economic advantage.

Additional support for our proposed distinction can be mounted by going back to the main source of inspiration for Baumol: Joseph Schumpeter. Whereas Baumol drew on the concept of new combinations, we build rather on the concept of the entrepreneur as a disturber of equilibrium. This neatly connects the discussion of different types of entrepreneurship with a more general theory of the political economy of growth. An equilibrium in a full-blown political economy model should always include both the production system and political and economic institutions. Both business and institutional entrepreneurs disturb this equilibrium, but do so in different parts of the model.

An important task for future research is to answer the question: Which features of institutions make them more amenable to innovative modification of their effectiveness? A result that emerges from our analysis is that such features would increase the susceptibility to institutional entrepreneurship. We hypothesize that institutional dimensions such as complexity and consistency are fruitful avenues for future research. To give some rationale for this hypothesis, consider the difference between countries with a highly complex tax code and those with a flat tax. *Prima facie*, our theory predicts that the former system breeds significantly more institutional entrepreneurship than the latter.

Our main conclusion is that entrepreneurial activities cannot be classified as socially wasteful without a contextual understanding of how they interact with the institutional setup, and possibly remedy for some of its deficiencies. This is an extension of the argument put forward in Rodrik (2008); institutional changes which at first sight look like improvement may in reality come into conflict with prevailing second-best solutions, thereby reducing the appropriateness of the institutional setup. And conversely: A ban on entrepreneurial activities that appear to be wasteful when gauged against a first-best institutional *Nirvana* may actually increase the cost of malfunctioning institutions.

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