Four Essays on Uncertainty, Trade Integration and Government Intervention

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by

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Abstract

This thesis contains four chapters. Chapter 1 presents a review of the theoretical and empirical literature concerning the role of government intervention, and in particular of industrial policies, in spurring development. The mainstream view on the use and effects of industrial policies is based on the market-failure approach. However, if the uncertain and the evolutionary nature of the development process is acknowledged, government intervention may well be a necessary condition for inducing growth. To support this view we consider the evidence on the Latin American and East Asian experiences in the last 50 years and we emphasize the similarity and the differences between the two regions concerning the type of policies implemented and results obtained. We discuss also how the introduction of the new WTO rules and the acceleration of the process of trade integration among countries has modified the available set of instruments, practices and institutions that support industrial development and how developing countries have adapted to the new scenario. Chapter 2 includes a model that shows that, when technologies are characterised by capital-skill complementarity and workers' mobility costs differ across skill categories, higher trade integration could explain rising wage inequality, both across and within skill categories in both developed and developing countries. In addition, the model demonstrates that a tax-financed re-training programme targeted to unskilled workers in the comparatively disadvantaged sector can reduce inequality and, at the same time, make free trade Pareto superior with respect to autarky. In chapter 3 and 4, we show how the predictions of standard trade theory about the effects of higher trade integration are modified when uncertainty is explicitly taken into consideration. The specific-factor model considered in chapter 3 illustrates how, when there is uncertainty (e.g. in the form of stochastic productivities) and workers are risk averse, increasing trade integration (beyond a certain level) may be welfare reducing. Changes in the country's specialization pattern also modify the way in which the cost of maintaining a tax-based insurance system, i.e. the Welfare State, is distributed across workers. Thus, the model identifies a trade-off, absent in the standard deterministic model, between gains from specialization (due to trade integration) and insurance gains (due to the working of the Welfare State). The main result of the model is that if the specialization level is too high, under a proper limitation of the parameters' space, the free trade aggregate expected income is shown to be lower than that achieved under autarky. Chapter 4 analyzes how increasing trade integration affects individual utility when the international specialization pattern is stochastic, i.e. when the number of varieties each country produces depends on the realization of a random variable. We introduce technological uncertainty in the Ricardian continuum of goods model and show that, also in this case, a trade off, similar to that considered in chapter 3, emerges in the model.

As in the standard theory, higher trade integration reduces prices and increases expected real income. However, higher trade integration, reducing the number of active sectors in the economy, also increases income variance and the displacement cost the worker would suffer in a bad state (i.e. when the sector she is employed into has to close down because, ex-post, the foreign country's competing sector results to be more efficient). The main result of the model is that there exists an optimal level of protection that it is higher the smaller the price reduction induced by trade integration and the more technologically similar are countries.

Contents

[1]This chapter is based on joint work with Carlo Devillanova and Pietro Vertova, Bocconi University, Milan

Chapter 1

Industrial Policies in Developing Countries: History and Perspectives

1.1 Introduction

In the last fifty years hundreds of books and journal articles have been written on if and how government intervention, in the form of industrial policies, have affected the growth process in developing countries. In the last decade, the dominating view has been that industrial policies are always bad and the market is the best coordinating mechanism at our disposal. This translated into the imposition of the *Washington Consensus* policy package as the fits-all solution for developing countries and the consolidation of *laisser-faire* as the political mantra.

But, at the turn of the Century, things have already changed and the industrial policy debate has came back. Two are the main reasons for this. First, the ideological adhesion to the neo-liberal dogma that have characterised the economic discipline during the last twenty years is now fading away. Indeed, the highly disappointing results of the more diligent in implementing the neo-liberal structural reforms (notably most of the Latin American countries) have shown the limitation of that recipe. The opponents to the *Washington Consensus* policy package have thus re-gained vigor in arguing for a different approach to development. Second, important new insights coming from both the theoretical and the empirical literature are seriously questioning some of the tenets on which the orthodox view was based upon.

In this note I define industrial policies as the policies that, trying to improve upon free market outcomes, aim at modifying the production structure and the export vector

of a country. In particular, industrial policies are said to include:

- policies concerning the working of financial institutions for industrial development
- trade polices
- innovation and technology policies
- education and skill formation polices
- sectoral competitiveness policies
- competition-regulation policies (i.e. policies influencing the market structure)

Obviously, an exhaustive literature review of such a large topic cannot be the objective of a single paper. Instead, this survey has two (more limited) aims. First, to offer an informed guideline into an extremely complex and politically relevant issue. Second, to answers to four important questions concerning the role played by industrial policies in the development process. These are:

1. which have been the effects of the industrial policies implemented during the last 50 years in Latin American and East Asian countries?
2. why similar policies produced different results in the two regions?
3. how have industrial policies changed during the last decades?
4. should governments implement industrial policies, and if yes, which are the good ones?

In trying answering these difficult questions, I will focus on the most important findings in both the theoretical and empirical literature but I will also give relevance to the historical dimension of the debate. In Section 1.2, I present the theoretical arguments that the economic profession has constructed in favour and against the use of industrial policy as an instrument to increase aggregate welfare. I show that recent contributions to this literature identify several cases in which industrial policies may be welfare increasing. In section 1.3, I describe the general features of the industrial policies implemented during the developmental State period. I discuss the empirical evidence on the effect on growth, technological accumulation and firms' performance of industrial policies comparing the East Asia and the South America experiences, during the period between the end of World War II and today. In section 1.4, I analyse how the introduction of the new WTO rules and the acceleration of the process of globalization of production has modified the available set of instruments, practices and

institutions to support industrial development. In section 1.5, I discuss some of the policy prescriptions that have been proposed in the literature. Section 1.6, I summarize the findings of the paper, discuss its limitations, and suggest some ideas for further research.

1.2 Industrial policies: the theoretical debate

In this section I review the most important theoretical contributions to the debate on the role and efficacy of industrial policies in inducing development and spurring growth. I will limit myself to consider only the arguments that, following the tradition of welfare economics, implicitly assume (sometimes implicitly) that the government is benevolent. Thus, what is at stake here is the ability of the government to achieve its 'good' objectives, not the way in which their are set.

1.2.1 Arguments *against* industrial polices

One of the most important neo-classical tenet is that the market is (always) the best allocative mechanism. A corollary of this is that any type of state intervention in the economy is necessarily welfare reducing, even if the government is 'benevolent', because this would distort the optimal equilibrium. The policy implication is that the less state in the economy the better it is. This is with no doubt still the dominant view in the profession and in the economic discourse. Indeed, even in the cases in which the market is clearly at least as inefficient as the state, the burden of the proof remains on the proponents of some sort of government intervention.

There are two main arguments to support the supremacy of the market over the government as the best coordinating device for an economy. The first, that I will call the 'information failure' argument, states that, even in the presence of highly imperfect markets, there is no reason to suppose that the government has better access to information with respect to the market (i.e. the firms). Thus the first cannot do better that the second. In addition, it is argued, it is very likely that the cost to collect information to correct market failures are higher than the benefits from such corrections. The best policy would be, thus, no policy because the market, if allowed to work properly, autonomously reaches the best equilibrium. Supporters of the market view also emphasize that, even assuming that the government knew more than the market, any selective policy would in any case produces a principal-agent problem in the form of moral hazard and/or adverse selection. Thus, *good* selectivity is impossible. The second argument against government intervention focuses on the

fact that whenever government intervenes a large room for corruption and rest-seeking activities is created. Thus, even if theoretically good, any targeted policies creates a waste of resources. In the following I present these two arguments in more detail.

Government failures The first argument against government intervention in the form of industrial policies is based on the idea (that dates back to Hayek) that market prices are the most important information source to guide economic activities and the best way to exploit it, it is to let the market to work freely. Government intervention should be avoided precisely because it is assumed to distort the proper 'natural' working of the market. The attempt of the government to substitute the market as coordinating device in the economy is never justified because it is never the case that the government may have access to better information concerning technologies and local production capabilities than firms have.

Since only the market 'knows', it follows that any selective intervention will only create additional inefficiencies. In particular, the literature has criticized the large use of the *picking winners strategy* by governments in developing countries on two grounds. The first is based on the information argument I have just mentioned. The ability of the government to select the 'right' sector to be promoted is assumed to be nil[1]. Thus any choice concerning sectors to be targeted is indeed a highly risky bet. The second is based on the theoretical results that, under the assumption of perfect competition, the provision of targeted policies is welfare reducing[2].

In the case of developing countries government intervention is considered to be even more harmful because two other negative effects add to the previous ones. The first is the fact that the design and implementation of industrial policies is very demanding of the technical and administrative skills in short supply in most developing countries. For this reason, employing highly educated persons in the public sector is far from costless and can have a crowding out effect on the private sector. Second, even if we assume a benevolent government and no conflict of interests between the different political actors, administrative difficulties for the badly organized developing countries ministers and agencies for development can be overwhelming. In addition, any government intervention 'creates' an agency problem[3]. And it is very unlikely that the 'weak' developing countries' governments are able to design the mechanisms and incentives

[1]For a discussion about the possibility to implement in an effective way the picking winner strategy see also sections 1.2.2 and 1.3.3

[2]Note that this result does not hold anymore in an imperfectly competitive setting. See section 1.2.2.

[3]This simply means that the principal-agent problem between the state and the 'targeted' agent is *not* different from the one that emerges between parties in a private contract (Chang, 1994).

that are needed to enforce the contract between them and the private sector [4].

Rent-seeking A second formidable opposition to the use of industrial policies comes from that large body of literature that indicate any kind of government intervention as the cause of a waste of resource due to lobbyists and the country's bureaucracy searching for rents[5]. These rent-seeking activities are indicated to increase by several times (and some time are much more relevant than) the cost of resource mis-allocation and price distortions induced by government interventions (Krueger, 1974; 1990). The argument is the following. Since any industrial policy (i.e. import licenses, investment permits, etc.) creates rents, firms find it profitable to invest resources to obtain them. These rent-seeking activities generates additional unproductive waste of resources. These can take several forms: for instance payment to lobbyists that works to obtain licenses; side-payments to bureaucrats, etc.[6]

In order to increase growth, thus, the government should limit its activity as much as possible because this would automatically give less room to possible rent-seeking activities. Particularly important and effective in this sense is argued to be the reduction of the large government intervention in the trade sphere. Indeed, opening up the economy is assumed to be able to automatically spur growth because it would allow the exploitation of international technological spillovers that are limited by trade (government imposed) barriers. The same type of analysis indicates that, since different type of government interventions allow for different possibility of rent seeking behaviors, if any policy should be implemented, it should be horizontal and not selective, being the latter much more 'dangerous' than the former. For example, it is undoubtedly true that a uniform tax system may be more impervious to lobbying than one with a highly differentiated structure (Krugman, 1993)[7].

[4]According to Amsden (2001) the effectiveness of the government monitoring of the private sector behaviour is one of the reason for the East Asian countries' success. The lack of this ability is, instead, one of the reason for the Latin American countries failure. For a discussion of the need for monitoring and an overview of the different instruments used see also section 1.3.3.

[5]See Bhagwati (1982) for a theoretical generalization.

[6]The New Political Economy has been largely inspired by the rent-seeking literature. Its main point is the recognition that governments and politicians must be seen as rational economic agents: thus, as everybody else, they seek to maximize their own welfare (for example increasing as much as possible the budget allocated to their ministry). Obviously, there is no reason to expect that this objective is coherent with the maximisation of aggregate welfare.

[7]Despite its theoretical appeal, the historical evidence challenges some of the conclusions of the rent-seeking literature. It is now widely recognized that the lack of rent-seeking behaviour in East Asia countries was not due to outward oriented policies *per se*. For throughout discussion see Change (1994). Instead, the key has been the genuine commitment of the state to growth and to the existence of a rent-seeking reducing institutional setting. Indeed Rodrik (1995a) notes that in Turkey, for instance, when policy moved toward outward orientation, rent-seekers just stopped running after import licenses and started looking for export subsidies.

1.2.2 Arguments *in favor* of industrial polices

The basic argument in favour of industrial policies is based on the idea that they have to repair the presence of some type of *market failure*. While when markets works perfectly government intervention is always detrimental to welfare (Grossman, 1990), this is not true when the market mechanisms fail to equate private and social costs and benefits. In these cases, as stated by the second Welfare Theorem, government intervention *can* indeed improve upon the free market outcome and increase welfare.

Market failures emerge when (i) there is imperfect competition: (ii) in the presence of a public good, or (iii) of some form of externality. I will discuss these situations and the infant industry argument in the following paragraphs. I will conclude the section presenting the evolutionary approach to this complex set of issues, emphasizing the points that differentiate it from the *market failure* approach.

Imperfect competition Imperfect competition may result either because of (i) characteristics of the production technology; 2) an anti-competitive firms behaviour. The first case is originated by the presence of increasing returns to scale. Under this circumstance, firms may operate at a sub-optimal level of production and a gap between the price and the marginal costs may emerge. In this case, the government can increase welfare using a subsidy or some form of trade protection that, allowing the increase in the scale of production, would reduce firm's costs[8]. A critic to this view argues that opening to trade may be a perfect substitute for government intervention, because, through the enlargement of the market, firms can exploit their increasing returns to scale and thus reduce costs. In fact, this would be true only if domestic firms were able to survive and then win international competition when the country enters free trade. The underlaying assumption is that the economic actors are identical and that developed and developing world firms, sharing the same technology, can compete in a plain field. But this is simply not true if we agree that different actors have different capabilities and that institutions matter for economic performance. Thus, even if the critic remains theoretically founded, its empirical relevance is dubious.

When imperfect competition is the result of firms behavior the government can increase welfare in two ways. First, it can restore the 'competitive' output level (and thus optimality) trough the promotion of public ownership. Second, in the case in which the non-competitive environment is the result of a firms' collusive behaviour, it can use the anti-trust legislation to regulate the market. In both cases, government

[8]Rodrik (1995b) express some skepticisms with respect to real-world relevance of this theoretical result. The reason is that empirical studies seem to show limited evidence of increasing return to scale in developing countries.

intervention is optimal.

Coordination failures and externalities Government intervention can be also justified in any case in which the *private* return to investment is below the *social* return. There are several circumstances in which this can happen: the joint presence of economies of scale and demand spillovers; when the domestic market is too small and trade too costly; when there are pecuniary externalities to be exploited. For example, if the industrialization (i.e. investment in new technology) of one sector is the condition for the enlargement of the market for the others, government interventions, coordinating investments across sectors, would increase welfare. In this sense, industrial policies can be viewed as a coordination device to stimulate socially profitable investments in new activities[9]. But, Rodrik (1995b) argues that, also in this case, increasing outward orientation should be the optimal policy. Indeed, the required enlargement of the market do not need to be originated from the demand spillovers in the domestic economy (and thus to be a government's creation).

Another instrument to make private and social return to converge is the socialization of *investment risk* in particularly sensible sectors or activities. In this case, despite the obvious moral hazard risk it poses, the subsidization of the entry of firms in new or dangerous sectors may be economically beneficial for the country as a whole (Hausman and Rodrik, 2003).

Finally, government intervention can increase welfare by subsidizing large projects if either of two conditions are satisfied: 1) if this stimulates technical progress that then generate spillovers to the whole economy; ii) if this induces investments in other high productivity risky projects. Interestingly, this is a (ex-post) theoretical justification of the successful industrial policies adopted at the early stage of development in Germany, when the governments subsidized large projects and industries (Acemoglu and Zilibotti, 1997).

All these arguments contribute to offer a theoretical justification of the picking winner strategy by showing that, in the presence of increasing retuns and demand externalities or technological spillovers, government intervention may increases the economy real income inducing a *modification* of its comparative advantages (i.e. Pack and Westphal, 1986; Murphy et alt.1989; Krugman 1991). As we have seen in Section 1.2.1 a strong critic to this strategy is the fact that the government cannot make informed decision about the 'potential' comparative advantages of each sector when selecting where and how to intervene. In fact, Wade (1990) argues that what actually the gov-

[9]Recent contributions to this literature include Murphy at alt. (1989); Wang and Xie (2004); Krishna and Perez (2004).

ernment of the successful East Asian countries did was not to pick-up winners but to made them, irrespective of their *potential* comparative advantages. A coherent and integrated series of interventions can indeed *create* winners and increase welfare[10].

When uncertainty is explicitly taken into account and there are learning externalities the case for government intervention becomes even stronger. Hausmann and Rodrik (2003) present a model in which entrepreneurs do not know the cost structure of the new sectors. They also assume that this cost is 'reveled' (becoming public knowledge) only after the first firm enters the sector. In this case, because of the learning externality, a divergence between private and public benefit produced by the discovery process emerges. This implies that *laissez faire* is likely to induce an inefficiently low rate of discovery since the private return is lower than the social one. The problem is that the first-best policy - i.e. an entry subsidy, suffers from a moral hazard problem. Once received the subsidy, the entrant has little incentive to start the costly discover process. A second-best approach takes the form of *incentives* contingent on good performance.

The infant industry argument The infant industry argument is one of the oldest theoretical justification of the protection of industries from international trade and one of the most widely used instrument of selective intervention in developing countries[11] Economists generally agree that the presence of dynamic learning effects and the fulfillment of the Mill-Bastable Test constitute a valid case for infant industry protection[12].

The cost of protecting an *infant* industries are two. First, protection can impose high costs on consumers and domestic firms (especially if the infant industry produces intermediate goods). Second, protection *may* dilute the incentive to invest in capability development, the very process it is meant to foster. Possible solutions to this latter problem are: (a) to offer limited protection; (b) to impose performance requirements; (c) or to enforce early entry into export markets while maintaining domestic protection.

If conditions for an industry to be protected are satisfied, one still has to determine which is the best way to provide this protection. The theoretical literature generally concludes that protection provided by production subsidies is preferable to that provided by tariffs or quotas, as the latter additionally distorts consumption. Instead, Melitz (2003) argues that production subsidies may not be feasible due to government

[10]Interestingly, Rodrik (1995a) notes that entry restriction is optimal in the case of trade protection, because it would reduce duplication of fixed cost by domestic firms entering the protected market.

[11]According to Lall (2000) it has been the most popular and effective. For an evaluation see 1.3.2. For an early formalization of the infant industry argument see Dasgupta and Stiglitz (1988).

[12]The Mill-Bastable Test comprises two conditions: (1) protection must be temporary and that the infant industry must then mature and become viable without protection (Mill); (2) the cumulative net benefits provided by the protected industry exceed the cumulative costs of protection (Bastable).

fiscal constraints. He shows that the presence of adjustment costs and uncertainty concerning the learning curve confer an advantage to the quota over the other two policy instruments[13].

Among economist there is a widespread criticism against the infant industry argument. Indeed, though reasonable and intuitive, the Mill-Bastable Test is difficult to apply in practice since, as shown by Melitz (2003), the fulfillment of the test depends on the industrys learning potential, the speed of learning, and the degree of substitutability between the domestic and foreign goods. All these are (clearly) difficult to measure conditions[14].

Heterogeneity, innovation and international competition The evolutionary approach offers a quite different view on the way in which the role of policies should be discussed. Dosi (1988b) argues that it is totally misleading to consider policy intervention only as an 'optimal' response to the existence of some type of market failures. Instead, the evolutionary approach maintains that non-economic variables (and in particular government policies) and institutions, establishing rules of agents' behavior and interaction, are permanent features of the '*constitution of markets*' and an essential part of their correct working (Dosi, 1988b). This is so because public policies not only affect the behavior of agents but they also influence how their expectations and objectives are formed.

Where the interpretative deficiency of the 'market failure' approach is more evident is in relation to the role and working of innovation and technological change policies. While the mainstream view considers technology only as a residual, the evolutionary approach maintains that the understanding the process of learning is the key to explain firms (and countries) relative performance in an evolving environment (e.g. markets)(Nelson and Winter, 1982). Central to the evolutionary paradigm is the fundamental distinction between information and knowledge and the idea that firms cannot (and indeed do not) use and reproduce technology drawing it from the whole set of existing technological knowledge (Cimoli and Dosi, 1995). Instead, the highly differentiate nature of firms implies that each of them is likely to improve its own technological knowledge along given directions largely determined by each given technology, the firm past story and the institutional environment surrounding the firm. That agents are heterogeneous immediately implies the acknowledgment that market

[13]The advantage of the quota with respect to the subsidy or tariff is that its level of protection automatically declines as learning progresses (a desired property for welfare maximization). On the contrary, both subsides and tariff should be adjusted downward according to the pace of learning (and the information requirement can be extremely high).

[14]On this discussion see also: Wood, A. (ed.) (2003). Symposium on infant industries. *Oxford Development Studies*, vol. 31 (1).

failures cannot affect them in the same way. For instance, *ceteris paribus*, being a small firm in a developing country makes everything more complicated. This heterogeneity calls for 'differentiated', thus obviously selective, government interventions. Of this sort should be, for instance, the interventions aiming at facilitating the adoption of new technologies. Furthermore, since developing countries weaknesses in this respect are bigger, the case for policy intervention there is stronger (on this point see also section 1.3.2).

1.3 Industrial policies: historical experiences and empirical evidence

1.3.1 Government intervention in historical perspective

Even though theoretical results are often fundamental to give policy makers guidance, the historical and empirical evidence can be at least as useful. In addition, while the theory is not conclusive on the relative benefits and costs of government intervention, there is by now an enormous amount of historical evidence that confirms that all the nowadays developed countries have widely adopted targeted interventions in trade and industry during their catching-up process.

Government intervention has a long history. During the Reinassance the shared view was that not all the activities were able to contribute to growth in the same manner (this is the so-called *activity-specific* theory of economic development). Indeed, only nations with a large share of their production structure featuring dynamic increasing returns and high technology intensity were expected to quickly develop[15]. Thus, the State had the objective to create and protect such knowledge-producing activities (Reinert, 1999). To this end, governments:

- established an apprentice system
- established scientific academies
- supported and gave assistance to inventors (i.e. prestige and monetary rewards)
- created the system of patent protection for new inventions (Venice, XV century)

[15]This is the reason for which Reinert (1999) defines development as the process of creation of a '*dynamic rent* which labour, capital and governments collect' and then decide how to distribute. An implication of this view is that are some activities in which, much more than in others, there is a community of interest, between the entrepreneurs and the nation as a whole, to support them.

- established state owned manufactures[16]
- offered tax breaks and subsides to firms importing new technologies or knowledge
- imposed travel restriction to skilled labour
- raised export duties on raw materials (to insure that local producers have a cost advantage with respect to international competitors)

In addition, the State largely intervened inducing (but sometimes also forcing) entrepreneurs into new manufacturing activities and when this was not possible it acted by entrepreneur of last resort (Reinert, 1999)[17]. The State has also played a very important role in pushing the technological frontier by being a supplier of high quality demand for national production. Particularly important in this respect have been infrastructure projects and warfare[18].

Historically, a *strong* State, selecting and forcing the economy into activities characterized by increasing returns or high knowledge intensity has been an *obligatory* passage point in the development process of any nation (Reniert, 1999)[19]. Indeed, activity specific strategies of early development have been implemented in England in the XV century; U.S., Japan and Germany during the XIX century; Asian Tigers and Latin American countries starting from the 1950s. This interventionist view finds theoretical support in the work of Frederic List, who has been one of the most strenuous opponents to the classical vision of the 'night-watchman' State proposed by the followers of Adam Smith. List's starting point is a critic of the idea that the Britain dominance of world production in the first half of the nineteenth century was the result of some *natural* comparative advantage. According to List:

> '[Adan Smith] falsely maintains that these manufactures [the English ones] have originated in the natural course of things and of their own accord: notwithstanding that in every nation the political power interferes to give to this so-called natural course an artificial direction for the nation's own special advantage' (List, 1845).

[16]According to Sombart state-owned manufactures were the privileged 'places of learning'. Indeed, 'state owned enterprises served to set, not only a prototype example of industry, but also the pace and pattern for the new form of organisation. It was the state-owned enterprises which, due to the demands they created, often served as catalysts for the development of capitalist industries'. Cited in Reinert (1999).

[17]For instance, during the kingdom of Henry VII of England, entrepreneurs were forced to establish a textile industry.

[18]See Kosacoff and Katz (1998) for a description of the role of the Army in Latin American countries development during the ISI period.

[19]On the role of the *strong* State in the development process see also Section 1.3.3

Indeed, List explains British leadership as the effect of the country's supremacy in technology, in the number and quality of its institutions, and in the very high investment rate in manufacturing (Freeman, 2004). This analysis leads him to conclude that an active interventionist economic policy in a necessary condition in order to promote long term-development.

It is without doubt that the foundations of the German economic policy in the late XIX century are to be found in List's ideas. At the base of the German industrial policy there is the idea that economic progress depends on the building of 'mental capital'[20]. This, in turn, depends on the capacity of firms to assimilate the most advanced technologies available at the moment and to improve upon them (Freeman 2004). It was very clear to List and the German government's economists that importing technology, learning how to use them and finally improving upon them were the three necessary steps for catching-up. There were three main ways to acquire technology: (i) the migration to Germany of British inventors, specialized workers and entrepreneurs; (ii) the return of German entrepreneurs an inventors working in England; (iii) the development of an education and training system to transform the process of creation and diffusion of innovation in a continuous activity at the national level. This last channel has been particularly important in the German catching-up process. The German system proved to be much more effective than the English 'on the job' training system in dealing with the highly scientific nature of the second industrial revolution. For instance, German universities were the first to institutionalize a system of science laboratories and post-graduated training. The government's protectionist attitude, even if important in the country's development process, has not been the main cause for winning the competitive struggle with the 'free trader' Britain. Much more important has been gaining the technological lead also through the development of an excellent education system. It was indeed the leadership in the new technologies (namely chemical and electrical engineering) and their widespread application to the economic system that allowed Germany (and also USA) to catch-up Britain[21].

List's ideas have also deeply influenced the Japanese development model. After WWII an intense confrontation between the static comparative advantage view of the Bank of Japan and the dynamic *listian* view of the MITI (Ministry of International Trade and Industry) took place. While the first advocated for Japan a development path based on the exploitation of the country's comparative advantage in labour intensive production, the second envisaged growth as the effect of the modification of the

[20]By 'mental capital' List means what in modern terms is labelled 'human capital' or 'intellectual' capital. For a discussion on this point see Freeman (2004).

[21]The importance of the German banking system in the country's development process is also well documented. In particular, the lack of venture capital in Britain is one of the main reason for its decline vis-a-vis the German competitor (Landes, 1970).

economic structure through innovation and the *creation* of comparative advantages in dynamic sectors. The MITI approach prevailed and as in the German (and the USA) case the new Japanese model has been build up with a strong emphasis on the education system and with the idea that innovation is central to development. It was very clear to Japanese bureaucrats that to overtake the technological leaders the best way was the one chosen by Germany at the end of the XIX century: Japan had just to follow the beaten route. The new Japanese education system was designed to closely resemble the German model, because it appeared to offer the best results in terms of building innovative capabilities at both the firm and economy level. The education system was characterized by: (i) a high enrollment ratio; (ii) a bias toward scientific disciplines, and it was coupled with a peculiar continuous on-the job training at the firm level. The high quality education system was complemented by what Freeman (2004) identifies as the second ingredient of the Japanese success: a long-term approach to investment in which considerations about the dynamic of world demand had preeminent role in the identification of the strategic priorities in R&D investments. This long-term approach to private investment decision was encouraged by the government through the provision of a wide set of incentives[22].

The government has also played a fundamental role in the development process of late-comers. In the the 1930s, in most of Latin American countries governments started to implement a series of interventionist policies as part of what, later on, have been labelled the Import Substitution Industrialization (ISI) strategy. At the beginning, the ISI strategy was elaborated in order to protect the countries from the dramatic deterioration of the international prices of primary products (that took place from the late nineteenth century to the 1920s) and to the breakdown of the multilateral international trading system after the Great Depression (Ground, 1988). The fact that, thank to the use of these new policies, the major Latin American economies recovered sooner and more vigorously from the Great Depression than did most of the other underdeveloped countries demonstrated the potentiality of this alternative approach to development.

In the aftermath of WWII, the relationship between international trade and growth attracted (again) the attention of economists and politicians from developing countries in search for a recipe to rapid development. The international division of labour was believed to be the first cause of the differences in per-capita income between North and South. The basic idea was that, because of their specialization pattern (e.g. agricultural and primary commodities), developing country would have just loose from free trade. Two were the empirical facts supporting this view:

[22]For a description of Japanese policies in relation to electronic technologies, see Dosi (1984). For a deep analysis of the Japanese experience see also Noland and Pack (2002).

1. the secular deterioration of the net barter terms of trade (Prebisch, 1950; Singer, 1950)

2. the low income elasticity of demand of developing countries's export (Engel curve argument)

The corollary of this argument was that, since only trade in manufactures is beneficial to growth, in order to gain from trade, developing countries must first industrialize. At the time the common view was that more (or freer) market cannot bring such transformation. On the contrary, also considering the success of the ISI strategy in Latin America and of the centrally planned economies examples (i.e. URSS and India), the right instruments to use in order to induce structural change were agree upon to be (i) large and comprehensive planning; (ii) protection from international competition; (iii) subsidization of domestic investments.

1.3.2 Industrial policies in the developmental State(s) - general features

In the 1950s most if not all the governments of developing countries started to extensively intervene in the economy with the objective to spur the industrialization process. Government intervention in the form of targeted industrial polices was considered able to do what the market was not, namely improve firms performance, induce structural change and boost economic growth. In order to do achieve its objective the developmental State intervened on:

- the nature, the ownership structure and the mode of governance of business firms
- the economic signals and incentives profit-motivated agents face
- the opportunities of scientific and technological innovation
- the socially distributed learning and technological capabilities

The government interventionist attitude had also a clear political nature. For instance, the analysis of the South Korean Five-years Plans reveals that the basic motivation of State intervention has been the creation of an 'independent economy' (Chang, 1994). The policymakers' main objective was the reduction of both the structural balance of payments' deficit and the dependence on foreign savings for financing investments. Export growth and the creation of a domestic capital and intermediate

goods sectors were considered the solution to these problems. To this end, South Korean government shaped industrial development at a very detailed level and a large set of industrial polices was arranged.

In the following I describe how the (common) set of industrial policies have been variedly implemented by the developmental States starting from the 1950s, focusing on the historical experience of East Asian and Latin American countries. I group the different policies according to the taxonomy of the domains of policy intervention elaborated in Cimoli, Dosi, Nelson and Stiglitz (2006).

Targeted industrial support measures: development banking, credit rationing and fiscal incentives

At the beginning of the 1960s, in most of the developing countries capital formation was mainly driven by public sector's investments. While private domestic investment were marginal in all countries, FDI played an important role only in Brazil (because of its rich supply of raw materials and large domestic market), Malaysia (because of its supply of raw materials) and Taiwan[23]. Under this circumstances, governments created national development banks with the objective to facilitate the building and growth of the domestic manufacturing industry through facilitated credit concession. This was nothing new in economic history. Indeed, State-supported development banks had a fundamental role in spurring industrialization for late industrializers in Europe during the XIX century (Gerschenkron, 1962).

Table 1.1: **Share of development banks in total manufacturing investments, 1970-1990 (%)**

Country	1970	1980	1990
Brazil (BNDES)	11.0	18.7	18.1
India (AIFIs)	7.6	16.8	26.0
South Korea (Korea Development Bank)	44.7	10.1	15.3
Mexico (NAFINSA)	35.5	11.4	na

Source: Amsden (2001) based on National Development Banks data

The development bank was the State's agent for financing private and public investment and, since the end of WWII, it has been by far the most important source of long-term lending to industry (Table 1.1). Development banks raised capital at home and abroad, using it to buy equities in private and public firms and to lend to domestic

[23]See also Section 1.3.2 and Table 1.3.

firms at below-market interest rate. Their activity showed similar sequencing and targeting criteria in most of the countries (Table 1.2). The infrastructure sector was the first (in temporal order) to be financed because it was expected to create a substantial demand for locally made inputs. The participation into such large project turn out to be an important 'competency building' period for many national business groups. This 'learning' period has been particular important for Brazilian firms: indeed, many of the capital goods producers in the 1970s were spin-offs from firms that took part into large public infrastructure projects during the previous decade (Amsden, 2001). Later on, the higher share of lending became the one directed to the manufacturing industry.

Although targeting criteria varied across countries, the most common ones were: (i) large linkage effect; (ii) high market potential; (iii) high technology intensity; (iv) high-value added[24]. In East Asia development banks' loans were usually conditioned on the fulfillment of some requirements too. Usually these conditions were firm specific and included in the client's contract. One of the most used was a local content rule for the inputs used. This condition aimed at: (i) inducing domestic firms to develop their own technology and to source locally engineers and machinery, (ii) facilitating the build-up of national firms; (iii) enriching the technological content of domestic production; (iv) saving foreign exchange[25]. Development banks have also played a crucial role in supporting the process of technological accumulation (reserving special funds to finance programs for technological development) and the country's effort to increase export (giving exporting firms access to *long-term subsidised capital*).

Governments used development banks to condition firms' conduct. This attitude was particularly clear and also effective in South Korea. In the 1960s, the South Korean military regime nationalised all banks making the State controlling all the financial flows (and thus the investment decisions) in the economy. In addition, the regime started to tightly control foreign exchange, foreign loans and foreign direct investments. Investment subsides were mainly given under two forms: (i) loans at negative real interest rates; (ii) direct credit[26]. The government subsidized investments also through the socialization of the most risky ones. Entrepreneurs were induced to enter new strategic sectors by the guarantee that the State would have bailed them out

[24]India was an exception: the criteria were much more *political*. For instance, the government favoured small firms, regardless of the activity sector.

[25]For this reason local content rules were particularly important in a strategic industry such as the automobile industry. For a discussion of the Brazilian automobile industry under the ISI period see section 1.3.2

[26]It is interesting to note that the *rationalization* of credit concession implied by (i) ended up favouring *chaebols* reinforcing even more their predominant position in the South Korean economy (Chang, 1994).

Table 1.2: **Targeted industries by decades, selected countries**

Country	1950s	1960s	1970s	1980s	1990s
Brazil (BNDES)	chemicals basic metals & products	basic metals basic metals	basic metals chemicals	basic metals chemicals	pulp and paper chemicals
India (AIFIs)	food products textiles	chemicals textiles	chemicals machinery	chemicals textiles	chemicals basic metals and prod.
South Korea (KDB)	- -	textiles ceramics	machinery basic metals	machinery, basic basic metals	chemicals metals
Mexico (NAFINSA)	basic metals food products	transp. equipment basic metals	transp. equipment basic metals	basic metals machinery	basic metals machinery

Note: The two main manufacturing industries in each decades receiving the largest share of credit (largest listed first). Industry definitions vary by country.
Source: Amsden (2001) based on UNESCO data

in case the business would have resulted not profitable (Rodrik, 1995a)[27]. A process of partial liberalization of this totally State-controlled financial system took place at the end of the 1960s but it was rapidly reversed in 1972. Interest rates were lowered again and direct government control of the banking system was increased in order to channel capital to targeted sectors and firms. By the end of the 1970s, the share of the so-called policy loans was 60% of the total. Beside capital channeling policies, the government introduced extensive tax incentives for the selected industries. The special tax measures are estimated to have reduced the marginal corporate tax from 50% to 20% for targeted industries (Noland and Pack, 2002).

Also the Taiwan government maintained a relatively repressed financial system and made a widespread use of subsidised and directed credit. But, differently from the South Korean case, the government did not promote giant conglomerates and the entry into heavy industries. On the contrary, since the Taiwanese economy was characterised by a large number of medium and small enterprises, development banks intervention took the form of credit for technology innovation[28]. The largest recipients of loans were public utilities and the chemical industries while the most important subsidized credit program was for financing the import of raw materials. Taiwan had also an important fiscal incentive program, the Statute for Encouragement of Investments (SEI), under which participating firms could choose either tax exemption or accelerated depreciation on capital equipment. The SEI has been in place from 1961 to 1990 and it was available to both domestic and foreign firms with the targeted industries changing during the decades: all exporting sector (1960s), capital-intensive sectors (1970s), technology intensive sectors (1980s)[29].

The role and the effectives of development banks activities in Latin America have been much more heterogeneous than in the case of East Asia. At the two extreme there are Brazil and Argentina, with Chilean experience in the middle. The Brazilian national development bank (BNDES) palyed a central role in the country development process. As in the case of East Asian countries, the government's main objective was to create a domestic industry. But, differently from the case of South Korea and Taiwan, an additional constraint was present. The BNDES had to achieve this result preventing economic concentration from rising, in a country where income distribution was already highly unequal. The consequence of the decision of not worsening income

[27]A classical example of this type of government intervention is the entry of Hyunday in the shipbuilding industry, see Amsden (1989).

[28]On technology credit programs for SME in Taiwan see Lall (2003).

[29]In 1990 the SEI has been replaced by a more functionally oriented program named the Statute for the Upgrading of Industry (SUI). Under this new program, firms are eligible for tax relief based on their expenditure on R&D or on pollution-control; some industry specific incentives in the high-tech sectors were retained.

distribution was the renounce to create national manufacturing champions (Amsden, 2001). In any case the BNDES activity has been important in financing and helping the entry of Brazil in some strategic heavy industries (i.e. aircraft and spatial industry, communication). In Chile, a similar role has been played by CORFO (Corporacion de Fomento de la Produccion) that, during the 1950s and 1960s, financed both public and private investments in different sectors (in particular machinery and equipment). The CORFO programs allowed the building up of the industrial production structure of the country and facilitated the investment in human capital formation and innovation. Even though these programs were clearly effective, the neo-liberal structural reforms implemented by the military regime drastically reduced CORFO's role and the number of sectoral intervention. In Argentina, on the contrary, the development bank has never contributed to the development process because, due to mismanagement and corruption, the bank interrupted its activities as early as the 1940s (Lewis, 1990).

The concession for credit at favourable conditions to targeted sectors and firms has been an essential piece of the developments State toolbox but development banks' activity has been characterized by very different level of effectiveness. International comparisons have shown that the bank performance depended on: (1) the presence or not of some form of conditionality on the loans; (2) the ability of the bureaucracy to control and direct firms behaviour. Historical evidence shows that, with few exceptions, in Latin America control mechanisms or conditionality rules were in most of the case lacking while in East Asia they were always present. In addition, the administrative apparatus that in Latin American countries proved to be highly inefficient and in some cases corrupt did a very good job in most East Asia countries. These differences explain of the diversity in performance and in the contribution of the banks to the development process of the countries in the two regions.

The economic signals and incentives profit-motivated agents face: import substitution, trade policies and openness

Trade policies contribute to determine the degree of international competition pressure firms are exposed to and thus play an important role in influencing their investment decisions. For this reason, they have been a key part of the Import Substitution Industrialization (ISI) strategy that has characterised developing countries after WWII. At the beginning of the 1950s, protectionism and import substitution were common practices to all developing (and some developed) countries. The idea was to protect the domestic market in order to make it easier for domestic firms to learn, innovate and growth (see also section 1.3.2).

An interesting example of the contrasting effects of these polices is given by the

case of the machine tool industry in Latin America under the ISI. During the 1960s and 1970s, several Latin American countries attempted to develop a domestic machine tool industry as part of their import-substitution industrialization strategy. Machine tool was considered a strategic industry because most components had to be built in-house and this would have stimulated firms' innovation activities. Indeed, after an initial period in which companies were acquiring licenses for foreign technology and designs, own design and engineering have quickly became common among Latin American producers. But the protectionist polices that were part of the ISI strategy created a number of problems for the users. First, the prices of domestically produced machine tools were higher than the world ones. The reason for this was mainly the lack of scale economies and of production specialization. A second (and related) problem was the high costs of components. While domestically produced components were expensive due to a too small scale of production the imports of foreign ones was made expensive by the high trade barriers (i.e. tariffs and quotas) and transport costs. Third, imports were strictly controlled to reduce foreign competition. Even if imported machine tools were locally available, they were normally subjected to an import license. Although licensing requirements varied across countries and time, they were quite restrictive and normally involved: (i) justification of the purchase; (ii) proof of lack of local production; (iii) a certificate of availability of foreign exchange. The process was extremely complicated to be completed, subject to delays and (sometimes) to the approval of local manufacturers, who were afraid of foreign competition. As a result small firms' access to advanced machine tools was extremely limited and only public or multinationals firms could acquire foreign equipments (even if not always at the required moment) (Alcorta, 2000).

While during the ISI period a high level of protection was common to all developing countries, it has been very different the time that the 'protected' sectors needed to become exporting ones. Two are the elements that characterize the successful examples of export growth. The first is the degree of commitment of the government (and of the bureaucracy) to export success. In South Korea, under the Park Chung Hee military regime, there were monthly meetings between top government officials (chaired by the President) and leading exporters. Exports targets were set at the industry, product and firm level by bureaucrats who were also held responsible for achieving export targets in their respective industries, and had to keep in close touch with exporting enterprises. A second fundamental element is the existence of a set of policies and institutions created to mobilize export. Starting from the 1960s, in most of East Asian countries the import substitution policies have been usually *coupled* with export promotion policies. Firms were given subsides and the right to sell in the domestic market under the commitment to export. The super-profits earned through selling in the protected domestic market

were then invested in order to create the learning and scale economies necessary to export and thus to acquire new licenses. In South Korea import protection was high, prolonged and selective but, at the same time, the export performance was used as the discipline device for both firms and bureaucrats. In Taiwan exporters were given preferential tax treatment and access to credit on favourable terms. The government extensively used tariffs and quantitative restrictions in order to direct the sectoral evolution of the economy (Wade, 1990)[30]. Export growth has also been favored by the provision of long-term investment capital to those import substituting industries that were expected to become exporter. The commitment of the governments in the region to increase export is also demonstrated by the creation in all East Asian countries, during the ISI period, of highly skilled and professional trade promotion centers[31]. In Latin America, on the contrary, the implementation of active export policies have been much more limited. The only, partial, exception has been Brazil. Starting from the 1960s, the Brazilian government designed a set of export incentives in the form of tax rebates and duty drawbacks. A special program authorised duty-free imports or a firm-specific incentive package in exchange for the commitment to export.

The evaluation of the results of the use of trade policies for enhancing industrial development (and growth) is one of the most controversial[32]. For decades, a large body of theoretical literature has been strongly arguing that the removal of the distortions created by trade policies would have automatically enhanced technological innovation and growth. South Korea and Taiwan were usually cited as examples of how successful the outward-oriented economies are. Now, this naive (and ideological) position is starting being abandoned. Also neo-classical free trade supporters now recognize that the South Korea and Taiwan experiences cannot be ascribed to the export-led growth model of development, i.e. export boom induced by opening up to free trade (see Rodrik, 1995a and below). On the contrary, the impressive growth performances of South Korea and Taiwan are the result of the combination of several policy measures (e.g. credit subsides, tax incentives, selective protection etc.) implemented by their respective government in order to solve production coordination problems by directing private investments.

The view that free trade (and no government intervention) is not sufficient to sustain long-run growth is also supported by the experience of two famous *outward oriented*

[30]Note that conclusions of Wade (1990) are in open contrast with Little (1979) classical study where Taiwan's exceptional growth performance was primarily attributed to a low level of trade protection, the availability to exporters of inputs at international prices and a conservative macroeconomic policy.

[31]They are the Hong Kong Trade Development Council (HKTDC), Korean Trade Promotion Council (KOTRA), Taiwan's China External Trade Development Council (CETDC), Singapore Trade Development Board (SRDB). The main contribution of these organizations has been to help SMEs to establish contacts with foreign buyers and to enter new markets.

[32]On this point see also section 1.4.

economies: Honk Kong and Chile. Actually, Honk Kong is the only case in the world of a pure free trade country (which actually is a state-city). It had unique initial conditions: long *entrept* tradition, global trading links, established trade and financial infrastructure, presence of British companies with large spillovers in skills and information, and a large immigration of entrepreneurs, engineers and technicians from the mainland (Lall, 2003). The Honk Kong development model has been a combination of free trade with policies to attract FDI. Even if Hong Kong has become the developing countries's leader in manufactured exports in the 1970s, the lack of any government intervention has led to relatively little structural deepening of the economy. As a result, with rising wages, most manufacturing have shifted to lower wage countries, industrial and export growth stagnated or turned negative and the technology content of its export structure is nowadays the lowest among the NICs (Lall, 2000). Another interesting case is Chile. By 1955 Chile was one of the most industrialized country in Latin America (Table 1.9). Following the *coup d'etat* in September 1973, Chile started implementing neo-liberal structural reforms, being the first Latin American country to do so. The government drastically reduced its role in the development process. This resulted in, first of all, the abandonment of any active selective industrial and technological policy. The military government liberalized trade, privatized large public firms, deregulated the labour and the financial markets[33]. The exceptional export success that started in mid 80's has been ascribed to an orthodox implementation of the *Washington Consensus* policy package. Thus, Chile soon became a benchmark for several developing countries in the world (see World Bank, 1997). In fact, there are some problems with this interpretation. First, the effects of structural (neo-liberal) reforms on export performance are by no means easy to measure because of the considerably different (and increasingly pragmatic and unorthodox) ways in which the reform episodes have taken place since 1973 (Ffrench-Davis, 2001). Second, most of the now exporting sectors were the ones that have been targeted during the ISI period by CORFO and government agencies for industrial development. Moreover, whatever the reasons for the Chilean export success, some doubts are emerging about its sustainability. Military government reforms have forced the Chilean economy to specialise according to its static natural comparative advantages (i.e. the ones the country had developed until that time). After a strong de-industrialization process that has taken place during the military regime, the Chilean export vector now consists almost exclusively of natural resource-based products and standardized commodities with a low income elasticity of demand (i.e. mining and fruit). This implies that, given its characteristics, an increase of export cannot sustain growth in the long run and thus that industrial policies are

[33]It is interesting to note that the only exception to this during the regime were the nationally owned enterprises producing copper. The reason for this anomaly is the 10% obligatory transfer of profits from the copper producer firms to the Army. This anomaly has not yet been modified.

now more than ever needed to induce structural change and sustain the catching-up process (Cimoli and Di Maio, 2004).

The historical experiences of East Asian countries clearly show that protection is not *per se* harmful to growth. On the contrary, one of the keys to the success of East Asian countries has been indeed the selectivity of the country's seclusion (e.g. opening some markets to international competition and keeping other closed) (Amsden, 2001). In fact, import substitution polices performed poorly only when: (1) they were not complemented by export promoting polices; (ii) there was no external or internal competition. In particular, protection without any mechanism of control (i.e. foreign competition, standard based benefits transfers, etc.) has resulted in a failure (Amsden, 2001). Obviously, bad designed trade policy may also have very negative effects. There are several example of this in the way Latin American countries implemented the ISI strategy. For instance, several governments in the region imposed licenses to import capital goods with the objective of favouring domestic capital formation. But, since licenses were granted on the basis on installed capacity, the final effect was an extremely low level of capital utilisation. Equally harmful has been the mismanagement of the exchange rate. Differently from the East Asian countries, the Latin American ones have often adopted a largely over-evaluated exchange rate. This, making the import of capital goods cheaper, was a way to indirectly subsidy capital formation and innovation and, at the same time, to control inflation. But this strategy had also important shortcomings. First, it greatly penalized export. Second, favouring imports, did not favoured the creation of (domestic) production linkages that Hirschman (1958) argued were the key to development.

As the empirical evidence shows, (protectionist) trade policies alone are (obviously) not sufficient to induce growth and if they are bad designed can even depress the economy. But combined with other policies, they can be extremely effective. In particular, their positive impact is higher when they are coupled with export policies and targeted technological policies. In any case their main utility rests in the contribution they give to the creation of the temporary 'vacuum environment' that is so crucial for the take-off and that is normally enjoyed only by the technological leaders (Dosi, 1988b).

Opportunities of scientific and technological innovation: innovation polices and technological projects

The developmental State had the declared objective of enhancing domestic technological accumulation as a way to spur economic growth[34]. During the ISI period

[34]This view was strongly supported by Raul Prebisch and the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) during the 1950s and 1960s.

(1940s-1980s), governments in developing countries have tried to increase domestic technological capabilities using a large set of policies and approaches. These attempts have a long history and show mixed results.

Beginning from the 1940s, a large number of public firms and public research institutions were created in almost all Latin American countries. Public owned firms, creating departments in which imported technologies and products where modified to fit the local environment, quickly became the most important source of domestic R&D activity[35] In the 1950s, the first institutions coordinating scientific research activity were established in the region. They had all a similar objective: to promote science and technology advances and to coordinate and link scientific research with production activities[36]. During the 1960s and 1970s, a rich institutional infrastructure to support innovation and technological change was already in place in several Latin American countries. It was common for the national *development plans* to explicitly incorporated also a *Science and Technology program* whom objective was to coordinate research, establish priorities in R&D activities and to increase the cooperation between public research institutes and the private sector. National research councils were created in all countries with the objectives of: (i) funding technological development; (ii) coordinating R%D programs; (iii) diffusing technological information, (iv) administrating the property rights system. Also national legislation was used in order to increase domestic knowledge accumulation: for instance, in several countries[37], national laws forced foreign investors to disinvest in favour of local ones after some years and profit repatriation was legally limited (Alcorta and Peres, 1998). The direct involvement of the State in the knowledge accumulation process is testified by the fact that during the ISI period, more than the 80% of Science and Technology (S&T) total expenditure was public funded (Katz, 2000). Also development banks had an important role in financing programs for technological development. For instance, in Brazil the national development bank (BNDES) created two special funds to finance, respectively, training of specialised technical personnel and the development of local capital goods industry (Dahlman and Frischtak, 1993). In Mexico, the industrial technology development program FONEI started a risk-sharing program with the CONAYT and another one funded by the World Bank to subsidize technological adaptation and innovation

[35]The Army has, especially in Latin America, played an important role in this process of technological development. Indeed, public firms started producing not only public utilities (e.g. energy and telecommunications) but they also entered sectors that were considered strategic from a military point of view (e.g. steel, nuclear, petrochemical, etc...).

[36]The Brazilian Research Council (CNPq) was established in 1951. In Mexico the National Institute for Scientific Research (INIC) (that later will become the Consejo Nacional de Ciencia y Tecnólogia (CONACYT)) was founded in 1950. The Argentinian National Council for science and Technology was created in 1958 (Dahlman and Frischtak, 1993).

[37]These countries are Bolivia, Colombia, Ecuador, Peru, Venezuela.

(Alcorta and Peres, 1998).

Government's commitment to technology development has been even stronger in East Asia. The South Korean government supported domestic technological upgrading in several ways. The import of technology was strongly subsidized: transfer costs of patent rights and technology import fees were tax deductible; income from technology consulting was tax-exempt; and foreign engineers were exempt from income tax. Private R&D was directly promoted too. As the industrial sector matured and it expanded to more technologically advanced ones, government's role in financing domestic technological innovation has constantly increased. Much more than in the Latin American case, the East Asian governments also acted as venture capitalists and as pioneers, especially in high technology sectors as informatics, semiconductors and telecommunications. Taiwan is the most clear example of this. Given an industrial structure characterized by SMEs, the creation of high-tech firms needed an initial period of acquisition of foreign technologies. To this end the import, adaptation, diffusion and development of new technologies was heavily supported. The Taiwan's Industrial Technology Research Institute (ITRI), founded in 1973, has been constituted precisely for importing and rapidly diffusing advanced technologies to Taiwans firms. Indeed, the cooperation between the public and the private sector is a characteristic feature of the technological upgrading strategy of the country (Lall, 2003). But, the public sector has also developed new technologies by its own. Public enterprises entered several heavy and technological advanced industries when the private sector was unable to develop the necessary capabilities. In addition, the government elaborated a number of venture capital projects and comprehensive *technology plans* to guide the allocation of resources. During the industrialization process, there has been also a substantial effort to attract FDI in technologically advanced sectors in which domestic firms were still very weak. The government sought to maximize benefits from FDI for domestic firms by (i) promoting local sourcing and subcontracting; (ii) imposing local content rules and (iii) introducing the obligation for foreign firms to transfer skills and technology to subcontractors thus raising the technological capabilities of domestic firms. Beside the welcome policies for FDI, the favourite instruments for technology development have been the creation of *science parks* and *technology clusters*.

The objective of enhancing domestic technological knowledge accumulation was so central to the developmental State that one of the most used condition for receiving development banks' loans were *local content requirements*. Even though this type of conditions was at the same time the most difficult to evaluate and the most vulnerable to politically and economically powerful multinationals, there is anecdotical evidence showing how successful they have been. A very interesting case in this sense is the

automobile sector in Brazil.

Brazil started an automotive plan in 1956 as part of its ISI strategy. The automotive sector was targeted because it was thought to be able (i) to attract foreign capital and technology; (ii) to generate linkages and thus to act as a *leading sector* for the whole economy. In particular, the plan restricted imports and forced transnational automobile firms to accept local content rules in change for the permission to sell in the (large) domestic market[38]. This early experiment in sectoral planning proved to be successful. The automobile industry showed to have strong linkages and to generate externalities for the economy as a whole. Internal prices started to decrease since mid 1960s and foreign exchange savings were significant. By the beginning of the 1970s, the industry was relatively cost efficient by international standards (Shapiro, 1989). The conditions that made possible this success are mainly two: (i) the Brazilian market was large enough to make a domestic industry viable and to induce foreign investor to accept local content rules; (ii) the automobile was a luxury good. This allowed the produces to pass the burden of the cost of local content rules on the consumers. This successful story[39] shows that, even though they may appear quite unique, there are conditions under which transnational firms strategies and industrial policies can be complementary.

FDI and technological innovation The access to foreign technology is a fundamental pre-requisite for take-off. But the *form* in which this happens (i.e. FDI, the purchase of capital equipment, licensing, venture capital agreements, etc.) matters a lot. Indeed, it determines the possibility to develop domestic technological capabilities and thus has a great impact on the characteristics of the growth process.

Historically, FDI inflows have been (and still are) the most important of these forms of access, but developing countries have used this channel to very different extents (Table 1.3). Referring to their approach to FDI, it is possible to identify two groups of countries. Using Amsden's terminology, they are:

1. *Indipendentist*[40]: minimal reliance on FDI and MNCs. Technology development is based on the strengthening of domestic firms, there is a heavy emphasis on domestic skill building and R&D. There is a pervasive use of industrial policies in order to create *national champions*. In some cases the State acts as a venture capitalist or a pioneer.

[38]The required average local content share varied from 90% to 95% of the value (Shapiro, 1989)
[39]In 1987, the first Volkswagen model totally constructed in Brazil entered the U.S. market.
[40]South Korea, Taiwan, China, India.

Table 1.3: **Net foreign direct investments as percentage of gross domestic capital formation, 1960-1996**

	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-96
Argentina	1.0	0.5	0.2	1.2	2.0	4.4	9.2
Brazil	-	7.6	5.7	4.2	3.8	2.0	2.0
Chile	-1.3	3.0	-7.0	3.9	7.8	4.6	8.7
Mexico	3.5	4.4	4.1	3.4	3.2	7.1	13.7
South Korea	0.2	0.6	2.7	0.8	0.3	1.5	0.8
Taiwan	4.4	-4.9	1.5	1.0	0.8	1.7	1.4
Malaysia	-	10.2	12.3	12.5	11.9	8.7	20.2

Source: Amsden (2001) based on IMF data

2. *Integrationist*[41]

   (a) *Active*: technology development relies on the spillovers from MNCs. There is a significant use of selective policies to move into high value activities.

   (b) *Passive*: the attraction of MNCs is not selective and it is pursued through the use of a large number of welcoming policies, the offering of a stable macro environment, low wages, disciplined and semi-skilled labour and good location.

South Korea clearly belongs to the first group. Indeed, MNCs have played a marginal role in the South Korean development process. FDI were permitted when they were the only way of obtaining the technology or gaining access to world markets and also in that cases they were subject to tight State control[42].

On the contrary, MNCs have been the engine of Brazilian development. This depended on two elements. First, the fact that, since it was supported by a populist coalition, the government was 'fiscally weak'. Second, the enormous supply of raw materials that attracted numerous foreign multinational to the country (Amsden, 2001).

Also the Singapore's technological upgrading process has been dominated by MNCs, which provided state-of-the-art technologies and access to their global networks (Lall, 2000). Singapore's government attracted MNCs by using a wide set of welcome-policies, selective investments in skills, technology and infrastructure, all directed at meeting the specific needs of the *targeted* FDI (Lall, 1996). But, even though the country's export has become among the most hi-tech in the developing world, Singapore's domestic

[41]Indonesia, Malaysia, Thailand, Argentina, Brazil, Chile, Mexico, Turkey.

[42]In some cases foreign investors were forced to sell out after the technology had been absorbed locally.

technological capabilities are still relatively small.

Foreign investments and, in particular, foreign entrepreneurs have been of fundamental importance in the Argentinian development process. Their central role was a consequence of history (e.g. high immigration from Europe) and of the fact that it did not exist a development bank or any government institution for financing innovation and supporting domestic firms[43]. Given this particular and sometimes difficult situation, there has been only a weak attempt to select the type of FDI directed to the country.

An evaluation of the effects of science and technological polices The evaluation of the effects of government intervention on innovation activity during the ISI period in Latin America shows mixed results. Katz (2000) lists numerous country and sectoral studies supporting the view of a positive effect of industrial polices on the accumulation process of technological capabilities in the region[44]. In particular, several successful examples of product innovations and technological improvements are reported. Nonetheless, the innovative apparatus build around public intervention that started to take form during the ISI period has never become, contrary to the expectations, the engine of growth. The reasons for that are mainly two:

1. increasing foreign investments have always been considered the most effective development and innovation policy[45]

2. the Latin American national innovation systems (that have been predominantly build around public firms and public research institutes) have never been able to create strong cooperative link with the private sector. On the one hand, the public centers started to be increasingly characterised by a *bureaucratic* production of knowledge[46]: in particular knowledge transfer to local firms was not a priority at all (Katz, 2000). On the other hand (and this is a general contradiction in the implementation of public policies in the region), technology policies have never been effective because were the capitalists to 'control' the State and not, as in the East Asian case, the viceversa. Since the micro economic conduct was not regulated, Latin American capitalists behave like *rentiers* and did not respond to government incentives nor have interest in using the technology produced by

[43]See also Katz and Kosaccof (1989).

[44]For a list of sectoral and country studies see Katz (1987, 2000).

[45]Indeed, after WWII, Mexico, Brazil and Argentina strongly started looking for foreign investors willing to locally invest and building automobile, textile and pharmaceutical firms. Note that this in sharp contrast with the EA countries experiences.

[46]In these governmental agencies there was no mechanism of control based on the evaluation of results of the research activity.

public research institutes[47].

To this two elements, one must add a 'behavioural' consequence of the fact that, as we have seen, the Latin American version of the ISI strategy was characterized by high trade protection and subsidized credit. This protectionist environment favoured the emergence of a multitude of small and medium firms, which started their activities copying technologies and products that were already old compared with the international standard. In most of the cases, capital goods were second hand, most of the instruments were homemade and the organisation of production was based on traditional models (Katz, 1987). In general, domestic firms reacted to the non efficient diffusion of public produced technological knowledge with an innovative behaviour strongly characterised by incremental and adaptive innovation.

The East Asian experiences show, on the contrary, the positive effects of direct and extensive government intervention in the technological domain. In particular, the effectiveness of the implemented policies is made evident by the high level of technological dynamism that have characterized the Asian Tigers starting from the 1960s and by the continuous increase in the number of firms producing technologically complex products and competing in the world market (Kim and Nelson, 2000).

Socially distributed learning and technological capabilities: education and skill formation policies

A natural complement to innovation policies are education and skill formation policies. We have already seen how important education polices have been in the historical experiences of Germany and Japan. Similarly, they have been a fundamental part of the development strategy of the catching-up countries during the XX century. But also under this aspect the East Asian and the Latin America experiences have been considerably different.

As it is shown in Table 1.4, during the period 1960-1990, the increase in the general level of education has been remarkable in all the countries but Argentina, whom starting point in 1960s was already high.

The progresses are evident in any dimension of education, first of all the level of illiteracy (Table 1.5). But differences across regions are present. Indeed, the reduction of the illiteracy rate that took place in Latin America during the XX century was

[47]As a consequence, and somewhat paradoxically, the major contribution of the numerous public firms and public funded research centers could be said to have been the formation numerous skilled professionals that then moved also to the private sector. One exception is Chile were, during the ISI period, several research institutes were established and a strict cooperation between universities, firms and public agencies started.

Table 1.4: **Increase in Education (growth rates), 1960 -1990**

	Population	Primary	Secondary	Tertiary
Argentina	1.6	1.2	4.0	6.0
Brazil	2.1	7.3	11.5	16.1
Chile	1.8	2.5	4.1	12.9
Mexico	2.5	4.1	23.2	17.0
South Korea	1.8	0.7	13.7	17.1
North Atlantic	1.3	0.6	2.5	4.7

Source: Amsden (2001) based on UNESCO data

impressive relative to the levels of illiteracy at the beginning of the century, but less so relative to the levels of illiteracy in other countries. The Philippines and Thailand, for example, which in 1950 had illiteracy rates as high as Mexico and slightly lower than Brazil, achieved reductions in illiteracy much larger than those countries

Table 1.5: **Illiteracy rate, total (pop age > 15)**

	1900	1950	1960	1970	1980	1985	1990	1997
Argentina	53	14	9	7	6	5	5	3
Brazil	65	51	39	34	26	22	19	16
Chile	50	20	16	15	19	8	7	5
Mexico	77	35	35	26	17	15	13	10
South Korea	-	78		11	7	5	4	3
Philippines	51	-	40	17	17	10	5	5

Source: UNESCO statistical database

Also the increase in the years of educational attainment of the labor force has not been so impressive in Latin America. Considering that around 1980, adults in the region had completed (only) four years of schooling on average it is clear that the results are modest if compared with East Asian countries. Nonetheless, data indicate wide differences across Latin American countries. The most impressive gains are observed in Cuba, where educational attainment almost doubled between the 1940s and 1970s, while Argentina and Uruguay, some of the countries with the oldest educational traditions, show the lowest gains, reflecting in part the higher levels of education of their older population, but also missed opportunities.

Access to tertiary education in developing countries expanded most during the 1960s and 1970, albeit from extremely small levels. Table 1.6 presents gross enrollment rates in tertiary education. By the 1990s the access to higher education was lower in Latin America than in the East Asian countries. Whereas more than half of the relevant age

group attended a tertiary institution in South Korea, only Argentina had one third of the students attending colleges and universities, with the rest of the countries well below this level.

Table 1.6: **Gross enrollment ratios in tertiary education by access**

	1950	1960	1970	1975	1980	1985	1990	1995
Argentina	5	11	13	27	22	36	38	36
Brazil	1	2	5	10	11	-	11	15
Chile	2	4	9	15	12	16	21	28
Mexico	2	3	5	10	14	16	15	15
South Korea	-	-	7	9	15	34	39	52
Philippines	-	-	17	16	24	25	28	29
Singapore	-	-	6	8	8	14	19	34

Source: UNESCO statistical database

To sum up, in all developing countries the education systems expanded during the XX century. However, in Latin America, illiteracy levels remained higher than those of other countries in Asia, Europe and North America. The opportunity to enroll in schools and universities also increased, but access to secondary and tertiary education was significantly lower than in other regions.

The very good achievements of the education system in East Asian countries have been the result of active policies. This is particularly evident for South Korea and Taiwan[48]. Starting from very low level of education indicators, South Korea has constantly and heavily invested in education and high skill formation (Table 1.7). Later on, when South Korean industrial policy focused on high-tech sectors, the government started investing also in the creation of general and technical skills. In particular, the number of engineers as increased at impressive rate.

The supply of high skilled workers is one of the conditions that allowed the take off of the Asian Tigers. Indeed, by 1960 their educational indicators were much higher than the one of countries of comparable income[49]. The education system was strongly biased in favour of technical degrees and it was (and still is) characterised by an extremely high number engineers (Table 1.8). In this respect it is interesting to note that also Singapore, that with Honk Kong has been the less interventionist among the Asian Tigers, has heavily invested in education and training obtaining very high level

[48]For a throughout discussion on the role of education polices in the development process in East Asian countries see: Ashton, D., Green, F, James, D. and Sung, J. (eds.) (1999). *Education and training for development in East Asia.* Routledge, London.

[49]There was almost universal primary-school enrollment and the literacy rate was almost the double of countries of comparable income (Rodrik, 1995a).

Table 1.7: **South Korea - Science and Education Indicators, 1953-1987**

	1953	1970	1987
Literacy (%)	22	89	99
University (%)	3	9	26
Corporate R& D Laboratories (No.)	-	1	455
Researchers (No.)			
Universities	-	1918	17415
Gov. Research Institutes	-	2477	9184
Private industry	-	925	26104
R&D / GDP (%)	0.1	0.3	1.9

Source: Kim (1993)

of scientific education indicators. Indeed, there is no doubt that the acquisition of imported technology has been so well exploited because of the already available learning capabilities and technical knowledge.

Table 1.8: **Engineering, Science and Maths Students (% of population), 1987**

	Engineering	Eng., Science and Maths
Brazil	0.13	0.24
Japan	0.34	0.40
South Korea	0.54	0.76
Singapore	0.61	0.73
Taiwan	0.68	0.78

Source: Kim, 1993

From this brief overview it clearly emerges that a high-level education system has been a fundamental ingredient for catching-up. Accumulation of physical and human capital (which is the neo-classical recipe for development) are necessary but not sufficient conditions for growth. Indeed, development, far from being and automatic process generated by simple accumulation, is characterized by high uncertainty. For this reason, the education and formation system are called to provide high level and 'general', i.e. able to adapt to the different situations, human capital. In addition, and this is something that is usually disregarded, a high level of education is essential for both what Amsden (2001) calls the *indipendentist* and the *integrationist* model. Indeed, the building-up of domestic technological capabilities obviously calls for heavy investments in higher education. But this also true for the *integrationist* model because the import of technology is far from being an easy process and without infrastructural investment in education, training and R&D very little can be accomplished by just importing technologies (Dosi et alt., 1994). In addition, Nelson (2004) emphasizes that

in the current environment catch-up will be impossible unless a country builds up its education system from bottom to top[50]. Thus the university system and public laboratories have to reconquer the center of the stage because, as the development process proceeds, the needed number of scientists and engineers increases, and a larger share of education is going to *have* to be undertaken *indigenously*.

1.3.3 Summarizing the historical evidence and drawing some conclusions

Evaluating developmental State interventions Krueger (1990) lists a number of interesting examples of government failures in developing countries between the 1970s and the 1980s. She concludes arguing that there is overwhelming evidence that 'governments investment programs were highly inefficient and wasteful'[51] Particularly pernicious effects seems to have had the high level of protection of the domestic industry from foreign competition. As an example of the level of policy-induced distortions that were present in developing countries, Krueger (1990) reports that in Turkey effective protection rates (EPRs) of around 200% were frequent. Similarly high values of EPRs are found in studies on India and on other developing countries. Smith (2000), calculating the effective rate of assistance in the Taiwan economy during the period 1964-1988 shows that some sectors were producing negative value-added at world prices.

Other studies have focused on the effects of the government-led large industrialization plans. Noland and Pack (2002) put under severe scrutiny one of the most widely used examples of successful government policy intervention. They argue that the implementation of the Heavy and Chemical Industries (HCI) plan in South Korea in 1973, intented to encourage the engineering and chemical sectors and to produce the structural change in the economy, did not had a major impact on growth. They also cite evidence showing that the program had a detrimental impact on the business-government relations and increased corruption. According to their analysis the implementation of industrial policies in South Korea made evident two problems. First, the involvement of the State in both the implementation and the financing of industrial policies raised enormous problems of moral hazard and socialization of risk. In particular they point

[50] See also Freeman (2004) and section 1.3.1.

[51] Actually she motivates (in a rather unconvincing way) her conclusions saying that

> '[..] there is no evidence that living standards fell in the developing countries prior to 1950, a time when many observers associate with a period of *laissez-fare*. In many African countries, however, living standards have been falling since. The latter period has been one of active government intervention, and there no other obvious reason for the difference in performance in the two periods.' (Krueger, 1990, p.12).

to the fact that *chaebols* could use capital from subsidized projects to finance other ventures, confident that the government would not have allowed them to fail[52]. Second, the centrality of government-business relation for the corporate success increased the rent-seeking activity and the rate of corruption inhibiting, at the same time, foreign investments in the country[53]. More over, the results of Park and Known (1995) points to the fact that the HCI plan, strengthening the oligopolistic position of chaebols, also retarded technological change. In addition, Pack (2000) finds that TPF growth in the heavy and chemical industries was not sufficiently large as to have exerted a major impact on aggregate growth. A number of studies have also analysed the effectiveness of industrial policies in stimulating rapid growth in Taiwan. Smith (2000) finds that there is no significant causal relationship between industrial policy intervention and sectoral TFP or trade performance. Pack and Lin (2001), applying a different methodology, find that industrial policies can account for only a small proportion of Taiwan's success.

The view that targeted support to strategic industries has been the key to the take-off process in several developing countries because they allowed the targeted support to strategic industries is challenged by Noland and Pack (2002). Their analysis show that the pattern of industrial policies appears to be driven by political economy motivation like sectoral employment or the presence of large firms (that more easily may influence the government) rather than by the presence of dynamic comparative advantages. Their conclusion is that large part of the East Asian miracle should be instead attributed to good macroeconomic polices - i.e. low inflation rates, stable exchange rates and limited government deficits. In addition to that, some particular and irreproducible conditions have made possible the impressive growth experience of these countries - e.g. high competent bureaucracy; not too much unequal income distribution.

While these were the ones who 'denies' the merits of government intervention in spurring growth, nowadays numerous scholars share the view that the role of government in the development process has been much more effective than the orthodox account seems to suggest. As a matter of fact, starting from the end of WWII, government all around the world have largely used trade policies, subsides, public enterprises, direct credit allocation as instruments to *shape* comparative advantages and to guide

[52]Indeed, this view seems to be in contradiction with the empirical evidence. According to Amsden (1989) when a large scale firm was performing poorly because bad managed, instead of bail them out, the government was used to selected better managed *chaebols* to take over them. As a result, only three of the largest 10 chaebols in 1965 remained in the same list 10 years later. Similarly, seven of the largest 10 in 1975 remained on the same list in 1985 (Kim, 1993).

[53]This conclusion contrast with Chang (1994), who argue that rent-seeking waste of resources has been minimal in South Korea and surely cannot be blamed to have been (as in the case of e.g. Turkey and India) a major obstacle to growth.

investments and industrialization. Their results, clearly with some exceptions, are remarkable (Amsden, 1989, 2001; Wade, 1990).

Understandably, most of the attention in the discipline has been devoted to the analysis of the impressive economic performances of the so-called East Asian Tigers - i.e. South Korea, Taiwan, Singapore, Honk Kong. For a long time these results have been described as the 'natural' effect of correctly implemented export led-growth strategies (Krueger, 1985; World Bank, 1993). The orthodox account focuses, in particular, on the change in policies that took place between the mid 1950s and the 1960s in South Korea and Taiwan. In effect, at the end of 1950s, when the first stage of the import substitution strategy was already exhausted, governments in both countries started implementing polices aiming at inducing export growth (e.g. unification of exchange rates, a partial liberalisation of the import regime, etc.). Thus the export boom that took place in mid 1960s has been interpreted as the consequence of such policy change and of the fact that the countries had specialised according to their (static) comparative advantages. In this account the role of the State in the development process is very marginal. The government only sets the new rules favouring export and allows the markets to work freely: then, automatically, the economy takes-off. In fact the causal relationship between export and investments (and growth) have been the other way round, with the government playing the leading role. Rodrik (1995a) presents convincing evidence that in both South Korea and Taiwan export followed the investment growth. Export growth was a *consequence*, a forced response, to the increase of the demand for imported capital goods triggered by the investment boom[54]. The latter has been possible only because governments implemented a wide range of industrial policies meant to solve the (investment) coordination failures that were hindering growth and to induce entrepreneurs to invest in new strategic industries.

A large part of the discussion on the effectiveness of industrial policies in inducing growth has focused on one of the cornerstone of the developmental State strategy: *picking the winner*. As we have seen in section 1.2.1 the orthodox view argues that *good* selectivity is impossible. But the historical evidence that almost all countries have adopted the picking winner strategy. For example, in the 1960s the Taiwanese government hired for the Stanford Research Institute to identify promising industries in order to promote them using trade and industrial policies. In most of them Taiwan is now a world leader. To explain why this strategy has been successful Amsden (2001) correctly points out that, contrary to the neo-classical view, the picking winner strategy is indeed simple because, in the case of latecomers, the information requirement for implementing it is relatively small. To select the *right* sector thus it would be sufficient

[54]Indeed, the first objective of the government was keeping the balance of payment in equilibrium.

to see what developed countries have done and *just* imitate them[55]. In addition, as we have seen, in most of the cases governments have also *created* winners. The classical examples of the state-owned South Korean steel mill and of the Japanese automobile industry show that if an industry is not profitable at current price this does not mean it could not be made profitable if properly promoted (Chang, 1994). With respect to the developed world competitors, firms in developing countries suffer from a lower level of social capital and from the fact that they need a (possibly infinite) period of learning due to the tacit element of any new technology. These comparative disadvantages have been remedied using two instruments. First, the possibility of borrowing (and copying) foreign more advanced technologies eliminates the high sunk costs related to discovery and innovation. Second, government intervention offered the *additional* incentives that firms in developing countries need in order to adopt new technologies. The final result has often been that, because of lower labour cost and higher availability of raw materials, developing countries firms produced at lower costs than developed countries' competitors.

Amsden (2001) presents convincing evidence that in most of the cases *industrial polices* implemented by the different developmental States have induced a resource allocation and a specialization pattern that have shown to be efficient enough to withstand the free market test. Since the share of manufacturing in developing countries' total export soared, one goal of the industrial policies (i.e. induce the structural change in the economies) has surely been met. In addition, industrial policies have succeeded, in some cases, in creating also dynamic 'leading' sectors[56]. It s fair to conclude saying that, as emphasized by Katz (2000), the development State period period cannot be described, as it is commonly done in the profession, just as rent-seeking entrepreneurs meeting corrupted public servants. This description is at best incomplete in that it does not take into account the important transformation and the enormous technological improvements that took place in most of the economies. Indeed, during that period, both aggregate growth rate and factor productivity rose in all countries[57].

Explaining the difference in performance between East Asia and Latin America By the mid 1950s, the level of industrialization in Latin America was much higher than in East Asia (Table 1.9). Despite the different starting level, during the 1960s and 1970s, both Latin American and East Asian countries recorded high growth rates and experienced a strong catching-up process with respect to developed countries.

[55]On this point see also Rodrik (1995b).

[56]On this point see also Rodrik, 2004b.

[57]For a description of the transformation that the production structure of Latin America countries underwent during the ISI period, see Katz (1987).

Table 1.9: **Level of Industrialization - 1955**

	Ratio of manufacturing to agricultural net product	Net value of manufacturing per head
Venezuela	1.43	95
Chile	1.35	75
Argentina	1.32	145
Mexico	1.00	60
Brazil	0.72	50
India	0.30	7
Thailand	0.28	10
South Korea	0.20	8
Indonesia	0.20	10

Source: Maizels, 1963 (cited in Dosi et alt. (1994))

In particular, ISI policies were initially quite successful in inducing industrialization in Latin America. Between 1955 and 1975 the average growth rate of the manufacturing sector was 6.9% and its share in total output grew from around 17.5% to 29.6% in 1980 (ECLAC, 2000). But, by the 1980s, a process of differentiation between the two regions began. While East Asian countries continued their rapid growth, Latin American countries, also because of the 1982 crisis, entered the *decada perdida*.

The puzzle concerning the relative growth performance of East Asia and Latin American countries can be explained only by using complementary arguments[58]. The first suggests that the phase of strong divergence could be partially explained by the different learning and adoption capabilities that were present in the two regions when the new techno-economic paradigm based on the information and telecommunication technology emerged (Dosi et alt., 1994). The educational and technological infrastructures (results of systematic and well designed education and innovation policies) gave East Asian countries a strong advantage with respect to other developing countries in exploiting the opportunities offered by the ICT revolution.

A complementary explanation focuses on how similar policies have been implemented in radically different ways. It is by now a shared view that the recipe of the success of the East Asian economies has been the effective combination of incentives with discipline (Amsden, (2001); Hausmann and Rodrik (2003)). The former were provided through subsidies and protection, while the latter was obtained through direct government control and the use of export performance as a selection and monitoring device for both the entrepreneurs and the bureaucrats. The failure of the Latin Ameri-

[58]On this point see also Fishlow (1989).

can experience lies in the very lack of the joint presence of these two elements. Indeed, during the ISI period Latin American firms received considerable incentives, but faced very little discipline. The mistake has been to ignore efficiency considerations and to assume away capability problems. In effect, the idea was that the necessary capabilities were already available within the country, or that, in case, they would have been created automatically and without extra cost[59]. While this is for sure an important difference between the two models, it is not the only one. According to Lall (2003) the East Asian model was also based on:

- strict selectivity and time limitation of government intervention
- the use public enterprises to enter risky sector (for limited periods)
- massive investment in skill creation and technological and physical infrastructure building
- the centralization of strategic industrial decisions in competent authorities
- a highly selective use of FDI

There are two additional features of the East Asian model that are important in order to understand its success. First, governments have provided stable and predictable incentive frameworks that have favoured investments. Second, governments had close and continuous dialogue with the private sector, and, most importantly, it was 'strong'. Indeed, as in all the other developing countries where they have been implemented, industrial polices in East Asian countries did created also inefficient firms. But, differently from what happened elsewhere (i.e. Latin American countries) the State was able to withdraw support whenever firm's performance was not satisfactory and imposed exporting performance and fierce competition in domestic markets as selecting devices for firms to be targeted. Thus, for instance, in South Korea *chaebols* were privileged as a group, but individually they were subject to strict State discipline: they need to remain efficient in order to win the rents that otherwise would go to their competitors.

Even if it is possible to speak of a 'general Asian model', there are also important differences among the different country experiences. These can be mostly appreciated looking at the extent and variety of their industrial policies. As shown in Table 1.10, government intervention has been widespread in South Korea and Taiwan and much less relevant in Singapore and Hong Kong. Also technology policies have taken very different forms in East Asia. Both South Korea and Taiwan have heavily invested in the development of domestic innovation capabilities. On the contrary, for Singapore

[59]On this point see also Cimoli et alt. (2004).

Table 1.10: **Industrial Policies in East Asian countries during the developmental State**

	Pol. to deepen the industrial structure	Pol. to rise local content	Pol. to manage FDI entry	Pol. to raise techn. content	Pol. to promote large local firms
South Korea	•	•	•	•	•
Taiwan	•	•	•	•	
Singapore	•		•		
Honk Kong				•	

Source: Lall, 2003

and Hong Kong the main technology policy has always been attracting FDI. But each country model had also some *unique* characteristics. For example, an interesting aspect of the South Korean model is that policymakers thought that excessive competition could result in a waste of resources (Chang, 1994)[60]. Competition was considered only one, among the multiple available, means to achieve efficiency (and not an end in itself). Indeed, the idea is that, in the presence of specific assets, competition is not at all a costless selection process[61]. The second characteristic of the South Koren model was the large support given by the government to the creation and the promotion of giant conglomerates, the *chaebols* (Westphal, 1990). Interestingly enough, the rational for supporting the creation of these diversified and enormous conglomerates was the idea that they could internalize the numerous inefficiencies afflicting the domestic markets for capital, skills and technology.

The Latin American model was very different from the East Asian model and its main characteristics were:

- an 'anti-export' biased version of the ISI strategy
- the lack of clear performance criteria to evaluate the policies implemented
- the inexperience and inability of civil servants to implement the different policies
- the nationalistic ideology that made heavy industries producing for the Army the privileged targets of industrial policies (Katz and Kosacoff, 1998)

[60]On the importance of entry restriction as a policy to induce structural change and industrialization see also Hausmann and Rodrik (2003).

[61]Behind this view it can be clearly seen the influence the Japanese academia on the intellectual background of the South Korean economic bureaucracy. Indeed, during the Japanese occupation, the future top political and economic decision makers entered in contact with the principles of the the *Japanese variety of corporatism* making it then the reference point for the South Korean development model (Chang, 1994).

- a lower (with respect to the East Asian countries) expenditure in education and S&T as share of GDP

The Argentinian case is paradigmatic of the weaknesses of the Latin American model. At the beginning of the 1950s, Argentina had a per-capita GDP comparable to that of developed countries and its level of industrialization was the highest among the emerging economies (Table 1.9). But the attempt to further industrialize the country through government intervention has been quite disappointing. In particular, the failure is more evident if we consider the fact that Argentina was rich of natural endowments and it had the longest manufacturing experience, the highest level of education and per capita income among the countries of the region. The causes of the failure of government intervention are several but the most important are three: (i) there was no bureaucracy able to promote and coordinate industrial development; (ii) the civil servants were highly corrupted; (iii) a highly unequal distribution of income that made the implementation of any selective policy extremely difficult. Indeed, high inequality negatively affects the ability to implement industrial policies for two reasons:

1. due to the low income level and to substantial credit constraint, the labour force cannot become more skilled (which is a pre-condition to innovation and development)

2. a low income implies also a low saving rate

Thus, differently from what happened in South Korea, the government has never been able to strongly support large industry.

The weakness of Latin American version of the ISI strategy showed up also in the form of the dramatic 1982 financial crisis. That crisis was the result of one of the bottlenecks of the developmental State model, i.e. its inherent over-expansionist nature[62]. To up-grade their production, Latin American countries needed to constantly increase their import of more advanced capital goods. Increasing export should have been the 'correct' way to accumulate foreign exchange needed to pay import. The problem was that the Latin American ISI strategy was clearly anti-export biased. In addition, because of the domestic 'excess demand', there was no incentive for entrepreneurs to commit to export. A temporary solution was the increase of the foreign debt. But, by early 1980s, Latin American countries were no longer able to keep up with their payments (Alcorta and Peres, 1998). Thus, differently from what happened in East Asia,

[62]Stiglitz (2003) argues that the Latin American debt had become unsustainable not due to its inner forces, but because of a shock from the outside: the sudden, unexpected and unprecedented increase in interest rates in the United States. He concludes that most of the blame lies with the interest-rate shock imposed on the region from the United States.

Latin American countries underwent a long period of economic and political turbulence starting from the 1982 debt crisis. The economic performance of the region in the 1980s has been so poor to be labeled as the *decada perdida*[63]. Then, at the beginning of the 1990s, Latin American countries become the laboratory for the implementation of the most orthodox version of the *Washington Consensus* policies package[64].

Even if different, all these explanations jointly support the view that institutions and industrial policies played a fundamental role in determining the different growth performance. The question now is: *why has it been possible* to implement growth friendly industrial policies in East Asia and not elsewhere? Three are the crucial differences between East Asian and Latin American countries that have made (and still make) the former more adapt to be politically shaped. First, the absence of the opposition to social change that comes from the traditional land-owing class - which is still the most important obstacle to social change in Latin America. Second, the more equal distribution of income that allowed the rapid expansion of domestic markets without reducing the saving rate. Indeed, both these elements make institutional change easier and more responsive to the need of the new economic environment. Finally, there is a third important element, strictly related to previous two, to be considered: the fact that the East Asian State was much stronger than the Latin American one. But why, for example, was the South Korean state so strong? In that case, the strong nature of the State is an effect of military regime of General Park Chung Hee whom policy agenda have influenced the political economy of the country for decades[65]. The military government was so committed to growth that it also used its coercive power to intervene in the economic sphere[66]. But also the *direct* economic power of the State was substantial. Indeed, State control over strategic raw materials, banks and industries (e.g. through state-owned enterprises) was a powerful mean to control firms' behaviour. The situation was completely different in Latin America where, as we have seen, the capitalists *controlled* the State and not vice-versa. This had as a final effect the establishment of a *rentier* attitude of the capitalist class.

[63]The real GDP growth rates per capita in Latin America in the period 1980-1989 is -0.8% (see Table 1.11.

[64]I will not discuss the effect of the Reforms on Latin American countries' economies. Excellent analysis can be found in e.g. Peres and Stallings (2000) and Ocampo (2004).

[65]This is not to denied that other factors have contributed to make the South Korean state a particular strong one (i.e. the Confucian tradition, the absence of powerful social classes, the long tradition of centralized government). For a discussion of relative contribution of each of these elements see Chang (1994).

[66]It is paradigmatic the fact that one of the first act of the regime was to imprison many of the most important business men with the motivation of having accumulated wealth through illicit means. They were later on released in return to the promise to serve the nation trough enterprise (following the State designed development plans) (Chang, 1994).

1.4 'New' industrial polices in a neo-liberal world

1.4.1 The 'old' policies and the 'new' world

The industrial polices toolbox of the developmental State went under sever attack starting from mid 1970s. On the one hand the amount of empirical evidence and theoretical models showing the negative effects of industrial (and in particular trade policies) in developing countries made the case for policy reform increasingly stronger[67](Rodrik, 1995b). On the other, two 'real world' events forced the government to deeply modify their use of industrial policies. The first one was the explosion of the foreign debt and the consequent 1982 debt crisis[68]. The second was the proliferation of multilateral, regional and bilateral trade agreements that to a large extent limited the scope for government intervention.

In the last two decades, the 'old' set of industrial policies has been also challenged by the evolution of the economic context, that differs from the one of the developmental State period under, at least, three important aspects. First, *the rate of technological change is much more rapid*. This has important effects on the optimality of using technological policies. On the one hand, the cost of *any* type of control of the technological inflow (e.g. local content rules, capital goods import restrictions, etc.) would be much more expensive in terms of increasing the gap with the technological frontier. On the other hand, it is argued, it is the very nature of this increasingly knowledge demanding competition at the world level that calls for a more pervasive intervention in order to build the local capabilities that are necessary to absorb new technologies.

Second, as the process of globalisation of production proceeds, the *MNCs increasingly dominate international trade* (Lall, 2000). Indeed, the export pattern of most developing countries is now largely determined by FDI. Thus, under this new circumstance, some past policy instruments have become less useful if not counterproductive. For instance, the restriction to FDI is less feasible as a mean to induce the autonomous development of domestic technology knowledge: given the increasing complexity of the production technologies, few countries have the ability to match international innovation on their own. In addition, the ability to impose conditions on MNCs is also more limited, as more developing countries seek FDI. Note that the policy implication is not no-intervention. On the contrary, if the objective is to attract high value activities because it is more probable that they will generate positive spillovers to the domestic economy, the supply of a strong domestic enterprise base is the necessary condition to

[67]See also section 1.2.

[68]Amsden (2001) argue that also the 1997 Asian crisis can be directly reconducted to the inherently over-expansionist nature of the developmental State.

be met. Thus, as the Taiwan experience shows, the higher the quality of inward FDI that the country seeks to attract, the more targeted should be government intervention (Lall, 2000).

Third, *laisser faire* (i.e. *Washington Consensus* approach) is still the political tenet. Concerning government intervention, its implication is that any targeted industrial policy have to be avoided and that the only positive role for the government is to create the conditions for a well functioning market. But, even of this reflect the official view of most governments, it seems that things are rapidly changing and a re-thinking of the fundamentals of the neo-liberal approach has started. The failures and disappointing experiences in the last 15 years have been too many. In particular, where the *Washington Consensus* policies have been applied in the more orthodox way - Latin American countries -, the performance has been the worst both with respect to other developing countries and with respect to the ISI period (Stiglitz (2003); Castaldi et alt. (2004), Rodrik (2006) and Tables 1.11 and 1.12)[69]. According to Hausmann and Rodrik (2003), the *Washington Consensus* reforms have failed because they have not given sufficient incentives to entrepreneurs to start new sectors. Indeed, despite the mainstream view, opening to free trade and tighter domestic competition are not sufficient to induce investments into new sectors, which is the key to long-run growth. The deep causes of the low-growth performance were not thus the lack of access to new technologies or low property rights, the weakness that reforms were supposed to eliminate. Instead, what was missing were policies designed to cope with the uncertainty related with entering new sectors. The absence of policies designed to induce and support this *process of discovery* left developing countries stuck with their low-value added production set. In addition the competition pressure caused by the structural reforms implemented in the 1990s could have indeed worsened the inducement to innovate and to diversify[70]: firms faced a lot of discipline (exerted through foreign competition), but very little incentives.

Even if the *Washington Consensus* approach is now under severe scrutiny this does not mean that a return to the protectionist developmental State is neither the objective

[69]Nonetheless some leading economist is still incredulous with respect to these results. For example Tabellini (2004) writes:

> '[..] economic performance has deteriorated in the period 1980-2000, relative to the previous two decades. But *economic policies have generally improved* in the later period. Easterly (2001) and Rodrik (2003) point out that in the 1980s and onwards several developing countries adhered more closely to the so called Washington consensus of *good* policies (fiscal discipline, competitive currencies, privatization and deregulation, trade and financial liberalization). Yet, this did not prevent a decline in their growth rate (Tabellini, 2004, pag. 6, emphasizes added).

[70]Moreover, since reforms have increased productivity in traditional sectors alongside potential new activities, they may have increased the resource cost of entrepreneurship in the modern sectors.

Table 1.11: **Latin America: annual GDP rates of growth**

	1960-1970	1970-1980	1980-1990	1990-2001
GDP	5.32	5.86	1.18	3.05
GDP per capita	2.54	3.36	-0.80	1.39

Source: Stiglitz (2003) based on World Bank data

Table 1.12: **Latin America vs U.S.**
Excess of Latin America GDP growth rate with respect to U.S.

	1960-1970	1970-1980	1980-1990	1990-2001
GDP	1.42	2.58	-1.93	-0.46
GDP per capita	0.01	1.19	-2.95	-0.90

Source: Stiglitz (2003) based on World Bank data

nor the solution. What governments are in reality trying to do is to be the more pragmatic as possible (see section 1.4.2), also trying to comply with WTO obligations. An interesting question is indeed: how and to which extent do the new WTO rules limit government intervention? In particular, which are the consequences, in terms of ability to promote industrial development, of the prohibition to use large part of the industrial policies that have proven to be fundamental to the industrialization process in the past[71]?

The multilateral agreements had as a first effect the progressive reduction of tariff and non tariff barriers to trade (Table 1.13). The new WTO rules have also restricted the use of both selective subsides and safeguards. I consider them in turn.

Selective subsides Export subsides (also in the form of creation of Export Processing Zones, EPZ) and subsides for the use of domestic (rather than imported) inputs, are now prohibited[72]. Also local content requirements and quantitative restriction on imports are now illegal. As we have seen, export promotion polices have been a fundamental instrument of industrial policy during the developmental State era. But, as argued by Rodrik (2004b), the prohibition of the use of selective export promotion policies should not be blamed too much. Indeed, there seems to be very weak empirical evidence supporting the view that exports produce the technological and demand spillovers that are the theoretical justification of their subsidization. In any case the

[71]For instance, relatively high tariffs have accompanied all the major waves of industrialization: the first industrial revolution in the United Kingdom (1770-1830); the second industrial revolution in the North Atlantic (1870-1914); and late industrialization (1950-1995) (Amsden, 2000).

[72]Export subsided are still allowed for countries with per-capita income $\leq$ \$1000.

Table 1.13: **Trade-weighted tariff averages**

	Pre-Uruguay round	Post-Uruguay Round
Argentina	38.2	30.9
Brazil	40.7	27.0
Chile	34.9	24.9
India	71.4	32.4
Indonesia	20.4	36.4
South Korea	18.0	8.3
Mexico	46.1	33.7
United States	5.4	3.5
European Union	5.7	3.6

Source: Amsden (2000) based on GATT secretariat data

WTO rules still allow the use of trade policy interventions in the form of selective subsides to promote (i) domestic R&D; (ii) regional development; (iii) environmentalism.

Safeguards The WTO, like the GATT, enables members to use safeguards measure to protect themselves in two cases:

1. when imports can destabilizes their balance of payments (*Article XVIII*)
2. when foreign competition threatens their individual industries, due to
   - an import surge (*Article XIX* on temporary safeguards)
   - an unfair trade practice (*Article VI* on anti-dumping and countervailing duties).

The new WTO rules limits the duration of safeguards to eight years[73]. The imposition of a time limit to the use of safeguards is coherent with the attempt to make trade policies the more transparent as possible. For the same reason the WTO rules have forbidden the use of voluntary export restraint. In any case, in the event of an import threat, rather than invoking *Article XIX* on temporary safeguards, the common practice of several countries has become to raise tariffs. Indeed, developing countries have bound many of their tariffs at fairly high levels as the starting point for their entry into the WTO (Amsden, 2000). Thus, whenever they consider it necessary, they can now raise their tariffs till these levels and keep them there for eight years.

Summarizing we can say that the new WTO rules still give some opportunities for countries to promote and select strategic sectors. Indeed, a great deal of discre-

[73]The previous GATT rules did not place any limits on duration.

tionarity is left to the governments in promoting science and technology activities, in particular by subsidizing private and public R&D and incentivating firms to locate in 'science parks'. In effect, Rodrik (2004b) argues that the most serious obstacle for implementing industrial policies comes from bilateral agreements with U.S. in which developing countries give up 'voluntarily' a relevant part of their policy autonomy[74]. The U.S. are also the responsible for the extension of the Uruguay Round to trade in services, which includes foreign investment. In the interest of developed countries the TRIPs agreement has been designed to protect rather than liberalize the access to proprietary know-how. Indeed, it is now virtually impossible to employ strategies of reverse engineering and copying that have been so important during the developmental State period (see, for example, the South Korea case). It is clear that this limitation drastically reduces the possibilities to catch-up for developing country[75]. Some good news may come from new regional and multi-regional trade agreements if they become opportunities to implement larger industrial policy plans (see e.g. the MERCOSUR experience with the automobile sector) (Rodrik, 2004b).

1.4.2 The new policies: a regional overview

A closer look at the current behaviour of developing countries' governments shows that industrial policy and direct State intervention have far from disappeared. They have changed name and sometimes also content, but they are still there. In the following I will briefly discuss the characteristics of the most important policies as they have been implemented in Latin America and East Asia in the last two decades.

Latin America

There are three common elements to most of the official documents describing governments plans for industrial development in the region. First, it is evident an attempt to adopt a much realistic approach to policy design, taking into proper consideration the characteristics of the new international scenario. Second, there is a certain degree of national experimentation: the old lessons and the best practices are now well known, but autonomous paths are emerging. Third, even if the free trade scenario is accepted, governments' explicit objective is to modify the current international division of labour, increasing developing countries' export of manufacturing and decreasing their dependence from primary-sector related export.

[74]Particularly relevant in this sense is the fact that the restrictions concerning the protection of intellectual property rights that are contained in such agreements are more tighter than the one prescribed by the WTO.

[75]On this point see also Nelson (2004).

Two are the main characteristics of the set of industrial policies that are currently employed. First, tax incentives have a very marginal role. The reason for this is that they are seen as both sources of distortion in resource allocation and contributing factors to recurrent fiscal imbalances, with their sequel of macroeconomic destabilization (Melo, 2001). Second, in the last two decades, industrial policies have (mostly) been *competitiveness policies*: the objective has been to increase production efficiency and thus the world market shares of the existing sectors more than the creation of new ones. This objective has been pursued through: (i) international trade negotiations to obtain access to *new market*; (ii) the attraction of FDI and MNCs.

In recent years, in most Latin American countries, there has been a revival of the use of industrial policies, testified by the proliferation of new programs to increase export, productivity and output but also innovation capabilities and diversification of production. I review then in turn.

Export promotion policies In the last two decades, the favourite instrument to increase export has been the attraction of MNCs. According to Mortimore and Peres (1998) three set of instruments have been used:

1. the creation of EPZ, *maquiladoras* and the provision of tax breaks for foreign investors
2. the building of an efficient market environment (better law enforcement, amelioration of the physical infrastructures to reduce the country's distance from world market, etc..)
3. the supply of specialised factors of production (i.e. skilled workers, natural resources, etc...)

The most widely employed have been, by large, the first two. Concerning the third set, MNCs have been attracted mostly by offering them the possibility to exploit the host country's natural resources[76].

But governments have also provided export promotion policies for domestic producers. Those can be classified in three categories: 1) policies that affect the availability and/or cost of credit; 2) fiscal incentives; and 3) provision of non-financial services to exporters. As Table 1.14 and 1.15 show there is no shortage of incentives to increase export and each country has its own package. What are the results of this large effort? Actually, highly disappointing. as noted by Rodrik (2004b), for a long time EPZ and

[76]For an analysis of MNCs' behavior in Latin America see Mortimore and Peres (1998).

FDI have been particularly incentivated on the belief (supported also by economic research) that these activities were particularly productive of positive externalities and spillovers. But *new* empirical results question this view. First, it has been shown that the higher productivity of exporting firms is the result of a selection effect. Thus there is no clear benefit in subsiding them. Second, there is lack of evidence of substantial positive spillover effects from FDI. For this reason, subsidizing foreign investors is a 'silly policy' because it transfers from poor country taxpayers to rich country shareholders.

Table 1.14: **Financial incentives to export**

	Credit export agency	Export credit lines in Dev. Bank	Loans working capital	Finance for entire investment	Buyer's credit	Finance for marketing	Export credit insurance
Argentina	•		•	•	•	•	•
Bolivia							
Brazil		•	•		•		•
Chile		•	•		•	•	
Colombia	•		•		•	•	•
Costa Rica			•				
Ecuador			•				•
Mexico	•	•	•	•	•	•	•
Peru		•	•				
Uruguay		•	•				•
Venezuela	•		•		•		•

Source: Melo (2002)

Incentives to increase production and investments Table 1.16 reports the set of policies used by governments to increase the capacity of production of each economy (i.e. policies intended not to change the composition of output but 'just' to increase it). As it clearly emerges from the table, both horizontal and sectorally targeted policies are present. For instance, beside horizontal credit policies, several countries have special credit lines for favouring particular sectors and/or regions within the country. It is interesting to note that, while during the ISI period, the favourite target of any policy was the manufacturing sector, interventions are now mainly directed to the primary sector and to tourism[77]. In addition, while horizontal tax incentives are not very diffused, tax incentive for particular regions or sectors are widely used[78].

[77]Agriculture is still supported Argentina, Brazil, Mexico, Costa Rica and Dominican Republic (Acevedo, 2002).

[78]Horizontal tax incentive are, on the contrary, largely used in Caribbean countries.

Table 1.15: **Fiscal incentives to export**

	Tax refund schemes	Drawback schemes	Temporary admission schemes[a]	EPZ	Exemption internal taxes
Argentina	•	•	•	•	
Bolivia	•	•	•	•	
Brazil	•	•	•	•	
Chile	•	•			
Colombia	•	•	•	•	
Costa Rica		•	•	•	
Ecuador		•	•	•	
Mexico	•	•	•	•	
Peru	•	•		•	•
Uruguay	•	•	•	•	
Venezuela	•	•	•	•	

Source: Melo (2002)

[a]Temporary admission schemes allow exporting firms to import parts employed in export production with total or partial exemption from taxes and import duties - an example is the *maquiladora* regime. Note that in some cases, temporary admission schemes have a built-in subsidy component, which will have to be eliminated to comply with WTO rules.

Incentives for innovation and production upgrading The set of policy designed to support innovation and production upgrading can be divided into three (although strictly related) groups: 1) policies to foster the integration and strengthening of production chains[79]: 2) policies to promote technological modernization; and 3) policies to promote firms' investment in human capital.

The design and implementation of policies to promote technological modernization have been one of the main concerns of the governments in the region in the last two decades. The Brazilian program is currently the most articulated and ambitious of the region. It groups sectors into two classes. The first group includes those sectors where the country has already developed some technological capabilities, i.e. information technology and automation; aerospace technology; nuclear technology; agriculture. The second group consists of sectors where Brazils development is still very low, i.e. optical electronics, biotechnology. While the policies for the first group are intended to induce firms to invest themselves, for the second one the fundamental policy is the creation of public funded 'research centers of excellence' devoted to basic and applied research

In most countries, technology policies are now usually complemented by programs

[79]Mexico and Colombia are leaders in the implementation of these policies. While the targeted production chains in Mexico are 8, in Colombia they are almost 40.

Table 1.16: **Industrial policies in support of production and investments - Latin America**

Country	Loans for working capital	Loans for fixed assets	Loans to specific sectors	Credit programs particular regions	Horizontal tax incentives	Tax incentives specific sectors	Tax incentives particular regions
Argentina	•	•	•	•		mining forest	
Brazil	•	•	oil, natural gas telecom, software shipping, power sector motion picture ind.	•			•
Bolivia						mining	
Chile	•	•		•	•	forestry, oil nuclear materials	•
Colombia	•	•	motion picture industry	•			•
Costa Rica	•					forestry tourism	
Ecuador	•	•				mining tourism	
Mexico	•	•	motion picture industry		•	forestry, motion picture air and maritime transp. publishing industry	
Peru	•	•				mining tourism, oil	•
Uruguay	•	•			•	shipping, forestry military industry. airlines, newspapers motion picture ind. printing, hydrocarbons	
Venezuela	•	•			•	hydrocarbons and other primary sectors	

Source: Melo (2001)

for human-resource development. Important examples in this sense are the Mexican program to financially support firms re-training their workers and managers and the Brazilian government program offering training to high qualified professional.

Summarizing the current situation There are few doubts that policies' design has improved in the last decades. But there are still substantial problems for what concerns the implementation process and also its evaluation. As the East Asia experience suggests, a central element for the success of industrial policies is indeed the possibility to evaluate *both* (i) (how good has been) the process of implementation of a specific policy and (ii) the results obtained. Until now, the Latin American experiences have been disappointing under both aspect. First, the number of successfully implemented industrial polices is very low. In particular, they fail to be implemented because:

1. most of the times the projects are simple statements of wills and there is a lack of clarity in the objectives
2. the industrial (and in particular technology) policies lack a priority list
3. the human and financial resources to implement the policies are insufficient
4. institutional capabilities are still weak
5. the agreements between the government and the private firms are not well defined

In addition, since the economic signals theses policies send to the private sector are much 'weaker' than the protectionist policies of the ISI period, there is much more uncertainty about their working. The final result is that the entrepreneurs do not 'believe' the incentive system of the policies and do not exploit their possibilities for development. This vicious circle creates the idea that 'the policies do not work' (Peres, 2004). Second, there are very few evaluation studies of the results of the implemented policy. Most of the studies only describe what have happened *after* the implementation but they are not able to determine the role of the policies. Nonetheless, there is also anedoctical evidence of some positive experiments of cooperation between the government and the entrepreneurs concerning the design and sometimes also the implementation of industrial policies. In some cases the entrepreneurial association have also taken the lead in the policy proposal (i.e. Colombia and Mexico). Peres (2004) evaluates this trend positively because it goes in the direction of a co-responsibility attitude of the government and the private agents. On the contrary, apart from very few exceptions[80], workers unions and the academic community do not take part in the

[80]The worker union in the automobile sector in Brazil, and the academic community in the case of Colombia.

design nor in the policy implementation process.

Finally, it is interesting to note a schizophrenic political evaluation of the usefulness of industrial policies in Latin American countries. In countries where sectoral policy are said to be ineffectual or even harmful for the economy, they are widely used to sustain agriculture and tourism. This show how still 'political' and ideological is the discussion of this important issue in the region.

East Asia

During the last two decades, governments' interventions have focused on the achievement of two main objectives. First, to induce domestic firms to enlarge their scale of production. Second, to foster innovation and knowledge accumulation. Both objectives have been pursued implementing a combination of old and new industrial policies.

Inducing mergers and acquisitions Governments in the region have constantly induced, by using a number of different incentives and laws, domestic firms to become bigger, with the idea that size matters for competing at the world level. With this objective in the 1990s, South Korean government forced the biggest business firms to merge and acquire each other's subsidiaries. In exchange for that, *chaebols* received extensive tax benefits and financial support. The final effect has been an increase in economic concentration. To partially counter-balance this process, the government has started promoting technology based small firms in medium size sectors through the creation of favourite credit lines in the local or regional banks and establishing a venture capital industry.

The small scale problem is particularly evident for the Taiwan economy, which is still characterized by the preponderance of small and medium enterprises. To modify this situation, the Taiwanese government guided the restructuring of the domestic economy providing direct subsides and incentives for the creation of cooperation agreements between firms.

Starting from the second half of the 1990s the Chinese government adopted explicit policies to 'propel three to five Chinese firms into the ranks of *Fortune*'s largest enterprise by the year 2000 and to promote *zaibatsu-like* groups in strategic sectors' (Amsden, 2001). The objective to increase national firms size was pursed through domestic merger and reorganization and it took place in different sectors - e.g. petrochemicals, steel, automobile and the consumer goods industries.

Ironically, it has sometimes happened that this process of concentration has also been the effect of policies that were aimed at increasing competition. This is, for

example, the case of the 1991 India liberalization reforms. The abolition of industrial licensing and the reduction of the controls on imports and FDI were supposed to transform the economy from a rather closed oligopoly-controlled into a free market competitive one. In particular, this was the expected effect on the automobile sector. But the result has been an increase in market concentration of the domestic suppliers of the new foreign producers.

New incentives for innovation During the last two decades, governments have also made a strong effort to increase countries' knowledge assets. The results have been impressive. In most of the countries in the region both the GDP share of science and technology investments and the share of R&D spending in the manufacturing sector have increased. In addition, and differently from what happened in other countries (i.e. Latin American ones), the private's sector share in R&D have significantly increased, reaching in some cases figure comparable with the U.S. and Japan one.

These results have been the effect of the combination of a number of policies. Starting from the 1980s, governments in the region have gradually liberalized their technology transfer policies. This has increased the number of collaborations between domestic and foreign firms. At the same time the domestic IPRs regime have been strengthened, reducing the possibility of imitative reverse engineering. During the 1990s, governments' promotion of high-tech sectors has been rationalized and innovated upon. Taiwan increased the number of science park and restricted the admission criteria. In addition, in order to overcome the scale problem of R&D and technology investments related to the fact that industries are mainly populated by SMEs, the government has supported the creation of *R&D consortia*. According to Mathews (2002) this is the most successful and distinctive recent tool of industrial policy used in Taiwan. The objective is to encourage firms to cooperate in order to raise their technology knowledge and be able to compete in world markets[81]. Most of these consortia are in the information technology sectors but they have also emerged in the automotive engines, motor cycles, electric vehicles, and now in the services and financial sector as well (Mathews, 2002).

South Korea has continued to support the domestic creation of knowledge: in particular the government reorganized its numerous programs to foster innovation creating a unique national innovation master plan. The focus of the industrial policies has shifted from the promotion of strategic industries to the support and development of strategic activities within sectors, in particular innovation-related ones. In general the private sector has assumed a larger role. This is the result of a series of government incentives

[81]Note how different are this arrangements with respect to the usual ones, in which risk reduction is the main motivating force of R&D cooperation

- direct R&D subsides, preferential financing ad tax incentives - designed to induce firms to set-up formal R&D departments (Kim, 1993).

Starting form the 1990s, the Indian government has financed the creation of 'centers of excellence' in order to supply to national firms in strategic sector well prepared professional and technicians. In addition, the legislation concerning technology production was modified in order to make more profitable for private firms to engage in R&D.

During the 1990s, China has made a big effort to design and implement policies and programs to incentive innovation (see also table 1.17). The instruments used spanned from tax breaks and subsidized credit to the creation of science parks and national R&D projects (Amsden, 2001). Targeted industries were given tax breaks and loans at favourable condition from State banks. But the biggest innovation has been the creation of the Science and Technology (S&T) enterprises. Although these enterprises were nominally independent they are neither state-owned nor private and

> '[..] in granting S&T enterprises a special legal status, the government obliged them to meet certain requirements. These requirements included the percentage of technology personnel, the percentage of sales contributed by new products, the percentage of products exported, the allocation of retained earnings, etc.' (Lu, 1997: 235, cited in Amsden, 2001).

This, admittedly, sounds quite 'old' and not very orthodox. But, till now, it has shown to be quite successful. Are there any lessons to be learnt from this?

1.5 Which policies for development (if any)?

All the now developed countries have historically made large use of several industrial polices in order to induce structural change and growth. Thus, whether State intervention played a relevant role in supporting and fostering growth is not the subject of the debate anymore. The question now is: are there industrial policies, among the ones that have worked in the past, that can be useful also for the future? Which characteristics should the policy and the implementation process have in order to be successful? Is historical evidence useful in this search? Is there a fit-all recipe? The positions in the profession are very different.

A first group of scholars argue that the only good type of polices are the horizontal ones, and that more market is always the best solution. Noland and Pack belong to this 'orthodox' group. As we have seen in section 1.3.3, their analysis of the impact of in-

Table 1.17: **Industrial policies in support of production and investments - Asia**

Country	Loans for working capital	Loans for fixed assets	Loans to specific sectors	Credit programs particular regions	Horizontal tax incentives	Tax incentives specific sectors	Tax incentives particular regions
India	•	•	motion picture industry	•	•	infrastructures, ports manufactures of priority items electronic hardware/software	•
China	•	•	software	•	•	High-tech and IC manufactures	•
Malaysia	•	•	shipping industry shipyard industry	•	•	manufacturing sector agriculture, tourism software, computers and ICT ind.	•

Source: Rodrik (2004b)

dustrial policies on the growth performance of South Korea and Taiwan indicates that sectorally targeted policies were not the major source of aggregate economic growth (Noland and Pack, 2002). They conclude that the proper role for government should be limited to the provision of education, the building of a social infrastructure, the investment in public technology institutions. Krueger (1990) is even more restrictive concerning the role the government should have. Her starting point is the acknowledgment that any policy is (extremely) costly and that the existence of a market failure is not sufficient for advocating government intervention. When the cost-benefit analysis indicates that this is the case, she suggests that the preferred policies should be the ones with 1) lower information costs; 2) less scope for rent-seeking; 3) minimum bureaucracy input. Stressing her dis-confidence in the possibility to design such policies, she concludes that strengthening the working and enlarging the scope of the market is *always* the most efficient way of stimulating growth.

Other scholars have forcefully claimed that more market is not (always) the solution. Hausmann and Rodrik (2003), for instance, argue that government intervention is absolutely fundamental for producing the optimal level of *discovery* in the economy. The argument goes like that. The key to development is learning what one is good at producing. But since this discovery of country's cost structure is characterized by learning externalities, the market will produce an inefficiently low level of it. In this context, government intervention has two, temporally separated, objectives. First, it has to induce the efficient level of innovation encouraging entrepreneur to enter new sectors. Second, it has to eliminate from the sector unproductive firms. Discussing the different types of government intervention, they argue that *temporary trade protection* may increase expected profits of innovators, but it does so only for firms selling in the local market. Moreover, since it cannot discriminate between innovators and followers, it is an inefficient way of promoting innovation and self-discovery. Similarly, *export subsidies* cannot discriminate (ex ante) between innovators and followers but they can be relatively good at discriminating between successful and unsuccessful performers ex post[82]. Finally, *public sector credit* has the advantage that it can be made discretionary and thus, it can be targeted on innovators[83]. These characteristics make this policy able to obtain the selection objective of government intervention without the shortcomings of the previous two instruments. However, as always, with discretion also come problems of political influence, corruption or at least moral hazard.

Lall (2000) points out that it is the very process of globalization of production and

[82]Note that this strategy was actively used by the South Korean and Taiwanese governments during their industrial drives in the 1960s and 1970s. Recall that the new WTO rules have made such subsidies illegal. See section 1.4

[83]The same is true for *government guarantees* that transfer part of the risk of failure to the government.

the concurrent increased world rate of technical change and intensification of competition that makes the need for industrial polices in developing countries more urgent that ever. Without intervention the new 'free trade scenario' can condemn developing countries to lagging behind. In fact, the only sure effect of rapid exposure to global competition will be the disappearing of their fledgling industrial sectors and of their small base of local capabilities. Industrial policies are called for also to make the transition to free trade more effective. Indeed, for liberalisation to be growth enhancing, it should be gradual and supported by active police measures in factor markets. Actually, the poor effects of the implementation of the *Washington Consensus* packages in developing countries is the proof that this view has some true content.

Proposals for the 'optimal policies' to be implemented are numerous. On of the most provocative is put forward by Rodrik (2004a) who argues that a sizable and sustained depreciation of the real exchange rate may constitute the most effective industrial policy there is[84]. This idea is motivated by four observations:

- large real exchange rate changes have played a big role in some of the more recent growth accelerations
- most of the gains from diversification into non-traditional activities are likely to lie within manufactures and natural resource based products (i.e. tradables) rather than services and other non-tradables
- the magnitude of the inducement can be quite large
- this way to subsidize tradeble activities is completely market-friendly, requiring no micromanagement on the part of bureaucrats.

This idea is in clear conflict with Freeman (2004), who argues that:

> '[..] the success of leading countries in international technology and trade competition is heavily related to the *long term* policies that they have pursued over many decades, rather than any short term manipulation of currency exchange or exploitation of relative factor-cost advantages' (Freeman, 2004, pag. 565, emphasis added).

The central thesis of Freeman, supported by the historical experiences of Germany and Japan, is that (only) polices lasting half a century or more underlie the major shifts in competitiveness.

[84]Note that large real depreciations did not play a major role in early growth accelerations in East Asia during the 1960s.

Rodrik's proposal is coherent with the view according to which the role of *initial* conditions was fundamental in the East Asian countries' experience. Since these (supposedly) initial conditions - high level of education relative to income and equal distribution of income - are quite rare in other developing countries, the relevance of their experience for other countries, it is argued, may well be very limited (Rodrik, 1995a). Thus, the management of the exchange rate would remain as the sole viable alternative.

Other scholars (Amsden, 2001; Lall 2000, 2003), on the contrary, argue that the historical experience of the East Asian countries could be of great guidance to design effective industrial policies. In effect, despite the fact that the rules of the game have changed and that each country has special initial structural and socio-economic conditions, there are important lessons to be learned and applied: the most important is that 'initial' condition and comparative advantages can be (and historically have been) created. If this is the objective, then, there are few doubts that a leading role has to be played by a strong university system and high-level public research centers (Nelson, 2004). If it is true that increasing firms' learning and innovation performances is the main challenge for developing countries, the most difficult aspect is identifying which characteristics the public research system should have to contribute to it. This is not an easy task and it is not a short process. Indeed this view suggests once again the necessity of adopting a very long-term historical view in developing and applying industrial policies in order to create a sustained growth process.

1.6 Concluding remarks and further research

The dispute between market fanatics and government's intervention supporters is not over. After decades in which it seemed that we had a winner, things are now rapidly changing and what was dogma till yesterday is under severe criticism today.

This paper reviewed the most relevant empirical and theoretical results concerning the effects of industrial policy on the development process of latecomers countries, with a particular focus on the Latina American and East Asia experiences in the last 50 years. Concerning the theory, a number of recent contributions have shown that government intervention plays a fundamental role in inducing industrialization and growth. In particular, once the uncertain and evolutionary nature of the development process is acknowledged, it is easy to show that a State that works as risk taking inducer and provider of general insurance is welfare improving. Thus, industrial, and in particular technological, policies designed with these objectives would have a positive impact on growth.

But the empirical evidence suggest that general conditions for successful policies are difficult to identify. Nonetheless some useful indications emerge from the historical experiences of latecomers. First, recent analysis convincingly demonstrate that, contrary to the (old) orthodox view, outward orientation is not *panacea*. Instead, the most effective policies in spurring growth seem to be the ones direct to support investments in education and innovation. Second, selective policies need to be accompanied by *some* form of control mechanism. Admittedly, these results are not very useful in identify ready-to-wear policies. Indeed, it can be argues that the most important conclusion of this paper is that there are very few received truths and that, given some simple and general rules, there is a lot of room for experimentation and innovation. Try and error is the only way to figure out how to make government intervention and industrial policies beneficial to growth.

In this necessarily partial overview of such a large topic, at least two fundamental issues have been left behind the scene. First, I have not discussed the fundamental aspect of the transition between one set of policies to another one. Introducing a more dynamic oriented analysis the importance of compatibility consideration among different policies and institutions will emerge with even more strength. Thus, to fully understand what is feasible and could be effective in each setting, the determination of how each set of institutions co-evolve with other spheres of the economic domain (in particular technological one) would become crucial.

The second one is the political feasibility of any given policy. At what stage (i.e. proposal, design, implementation) do the different agents intervene? How do they enter the political arena and how do they interact with the public agencies? An analysis of the dynamics of private and civil servants' motivations and actions during the design and implementation process it is fundamental to understand the possible effects of industrial policies on growth. This is an extremely interesting topic in which new insights coming from the behavioral and experimental economics literature can be fruitfully incorporated in order to improve upon the quite disappointing (still ruling) New Political Economy approach. Indeed, the latter has the merit to have started questioning the naive hypothesis that the government is 'benevolent' but, because of its simplistic assumptions on the psychological motivation of bureaucrats, it ended up with an equally naive (and ideological) policy prescription: the elimination of the State will solve any problem. On the contrary, as shown by the theory and the empirical evidence here reviewed, the government should not be considered as the biggest part of the problem but as an important part of the solution.

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Chapter 2

Trade Integration and the Welfare Effects of Capital-Skill Complementarity*

2.1 Introduction

One of the most topical issues raised by trade integration concerns its redistributive effects. While opening to free trade is generally agreed upon to increase welfare, it is also considered a major cause of the increase in wage inequality occurred in the last decades in most countries. Moreover, free trade does not entail welfare gains for all, but it typically rewards some groups while harming others; this explains why liberalizing trade often meets strong political opposition.

This paper addresses the role of intersectoral labor mobility in shaping the redistributive effects of trade integration. To this end we model a two-sector small competitive economy in which each sector produces a single good combining capital, skilled labour and unskilled labour. Capital is internationally mobile; skilled and unskilled workers can move across sectors. We introduce workers' heterogeneity by allowing the mobility cost to differ between skill categories, and by adopting a production technology which exhibits capital-skill complementarity. The interaction between mobility costs and capital-skill complementarity turns out to be important in order to address the labour market effects of trade integration and, to the best of our knowledge, it has never been explored before.

The role of mobility costs in shaping the relations between trade integration and

*This chapter is based on joint work with Carlo Devillanova and Pietro Vertova, Bocconi University, Milan

inequality calls for the analysis of specific policies that, by reducing mobility costs, can tackle inequality at (possibly) some welfare cost. In order to address this issue, we model a public re-training program, intended at reducing the mobility cost of unskilled workers and financed by a proportional tax levied on skilled workers. We explore the redistributive and welfare effects of changes in the tax rate under alternative assumptions on the effectiveness of the program.

We characterize both the autarky and the free trade equilibrium. We study the effects of trade integration in terms of aggregate welfare – measured by an utilitarian social welfare function – and both across and within group wage inequality. We show that if the mobility cost of unskilled workers is high enough to prevent mobility, trade integration has a positive effect on aggregate welfare, but it increases both across and within group inequality. We also show that a lower mobility cost for unskilled workers implies both higher welfare and a lower wage inequality. The novelty of our model is that frictions in the reallocation of unskilled workers during the trade integration process might indeed cause an increase in both across and within group inequality. In our set-up the imperfect mobility of unskilled workers is the main source of the increase in within-group inequality induced by trade integration, whereas capital-skill complementarity is the main cause of the rise in between-group inequality. However the two factors are self-reinforcing: as we will see below, higher mobility costs imply also a higher wage premium and, at the same time, a higher degree of capital-skills complementarity implies a higher inequality within the category of unskilled workers. Our framework allows for analyzing the interrelations between these two dimensions. In particular, we show how a simple redistributive mechanism aiming at reducing the mobility costs of unskilled workers may help in absorbing the increase in both within-group and between-group inequality induced by trade integration. Notice that the mechanism explored in this paper does not require any difference in skill intensity between sectors and it is at work independently from the level of development of the country.

The public re-training program, by lowering the moving cost for unskilled workers, enhances their reallocation, thus reducing inequality[1]. In general, the effect of the re-training program on aggregate welfare turns out to depend on the efficiency of the training mechanism. In particular, we show that if training expenditures are sufficiently effective in reducing individuals' mobility cost, then there exists a positive tax rate such that the provision of public training maximize social welfare. Moreover, even when the public training programme entails some welfare losses, it makes trade integration Pareto superior with respect to autarky.

[1]Notice that, by taxing the wage of skilled workers, it also reduces net of taxes wage differentials between types of workers and therefore an increase in the tax rate unambiguously reduces inequality.

The paper is organized as follows: in Section 2.2 we briefly review the literature on the effects of trade liberalisation on inter-industry (and intra-industry) labour reallocation. In addition, we discuss the evidence concerning the different level of mobility between sectors and firms of educated and less educated workers. Section 4.2 provides the basic economic set-up and Section 3.3 analyzes the effects of trade liberalisation on aggregate welfare and both within and across group wage inequality. It also studies the effects of the introduction of a public training scheme. Section 4.4 concludes.

2.2 Related literature

The literature on wage inequality and its relationship with international trade is, by now, extremely vast. The interest in the field has been largely motivated by the dramatic increase in both across and within-skill group wage inequality which has occurred in several developed countries (DCs) and, remarkably, in the US during recent decades (see Katz and Autor, 2000).

The benchmark theoretical linkage between trade integration and across group wage inequality is the Stolper-Samuelson theorem: since DCs are assumed to have a comparative advantage in skilled-intensive productions, it follows that the process of specialization induced by trade integration implies an increase in the relative demand for skilled workers, thereby rising the skill premium. A specular pattern of specialization would also entail a reduction of wage inequality in less developed countries (LDCs). However, existing evidence suggests that several LDCs experience rising wage inequality after trade liberalisation episodes (see inter alia Harrison and Hanson, 1999; Arbache et al., 2004). Recent contributions try to solve this puzzle, proposing different linkages between trade integration and wage inequality – see for example Acemoglu (2003), Xu (2003), Epifani and Gancia (2004), Verhoogen (2004) and references cited therein[2].

A second, important prediction of classical trade models is that, when a country opens to international trade, factors reallocate across sectors and firms. Indeed, it is this factor reallocation that allows the country to exploit its comparative advantages and to reap the benefits of trade integration. Nevertheless, if the labour market is characterised by imperfect mobility, the benefits of trade integration cannot be fully exploited and, at the same time, within group inequality (between similar workers

[2]In particular great attention has been paid to study the interaction between trade, skill-biased technological change and increasing returns to scale and how these may be simultaneous causes of both the process of skill upgrading and inequality increase (Goldberg and Pavcnik, 2004). Our comparative static approach, here adopted to make tractable the model, does not explicitly allow for the consideration of technological change.

employed in different sectors) would increase. Empirical evidence suggests that the imperfect mobility of workers is a relevant issue, implying that labour reallocation after trade integration is in general low - see Papageorgious et al. (1991) and Wacziarg and Wallack (2004). Lately, a few contributions address the issue linking the effects of trade integration to job security regulations, which is often maintained to be the major sources of frictions in the labour market – see Andersen and Skanksen (2003).

Remarkably, the joint effect of trade integration and intersectoral labour mobility on both dimensions of inequality – within and across group inequality – can hardly be addressed in existing theoretical models and, to the best of our knowledge, it has never been addressed before. The existing models are not suitable to explore this effect since they either assume that workers are sector specific, as in Acemoglu (2003), or they adopt a specification of the production technology which implies that the average skill premium is constant (i.e. a Cobb-Douglas production function in capital and aggregate labor).

Here is where our paper tries to contribute to the existing literature. We develop a theoretical model which allows us to study the interplay between trade integration, (imperfect) labor mobility and wage inequality, both across and within skill categories. Two features of the model are crucial in our analysis and allows us to link trade, internal labour reallocation and inequality: moving costs can differ between categories of workers and the production technology exhibits capital-skill complementarity[3]. Both features involve some notion of heterogeneity between skill categories and deserve a brief discussion.

First, we assume that the cost of moving across sectors is higher for unskilled workers than for skilled workers. The idea behind this assumption is that skilled workers have more general abilities, which can easily been transferred between occupations and sectors; on the contrary, less skilled workers are characterized by less transferable abilities. Existing evidence seems to support the hypothesis of higher internal mobility (across industry, sectors and geographical areas) of more educated workers: it has been shown that high educated workers possess more ability in the job search and lower transaction costs – see, for instance, Greenwood (1975), Bednarzik (1993) and Helwing (2001) – they can more easily learn and implement new tasks and technology – see Nelson and Phelps (1966) and Bartel and Lichtenberg (1987) – and they exhibit an higher propensity to voluntarily change their job – Magnani (2000) and Tomkins and Twomey (2000). Furthermore, there is some evidence that more educated work-

[3]The mechanism explored in this paper is inspired by Devillanova (2004). Differently from our paper, the author focuses on internal mobility driven by regional productivity differentials, in an economy closed to international trade. Furthermore, he assumes complete immobility of unskilled workers and does not consider any form of public intervention.

ers spend less time without a job when they are displaced (Bednarzik, 1993; Helwing, 2001), suggesting that higher education is positively correlated with the ability to learn and perform new tasks. This hypothesis seems particularly adapt to capture the different degrees of workers' mobility in those sectors affected by technological changes of a general purpose nature in last decades[4]. As pointed out by Aghion, Howitt and Violante (2002), a more general technology allows for a larger degree of transferability of skills across the different sectors of the economy, implying that more skilled workers are more mobile across sectors than unskilled workers. Here we stress that the assumption does not need to hold for the whole spectrum of qualifications, and indeed it is possible to provide examples of less qualified workers performing more generic tasks which might well change industry or sector more easily than more educated workers. With more than two skill groups we could intersect formal qualifications (unskilled vs. skilled) and tasks (sector specific vs. generic) and address more carefully the relative mobility of the resulting groups. In our simplified framework, with only two types of workers, we conform to a standard notion in the literature of education and overlap formal qualification and generic, more easily transferable, abilities.

Second, the constant return to scale production technology exhibits capital skill complementarity: i.e. capital better substitutes unskilled labour than skilled labour. Put in different terms, skilled are endowed with more capital than unskilled (Griliches, 1969; Krusell et al., 2000; Caselli, 1999). This assumption has received strong empirical support and it has been shown to be crucial in order to establish a link between internal mobility and across group wage inequality[5].

As a final remark, notice that in our model the production function is the same in both sectors, apart from a multiplicative parameter capturing the relative productivity of sectors. This assumption has two main advantages. First, it allows us to focus exclusively on the effect of trade integration on wage inequality occurring through the channel identified in this paper – namely, the interaction between the induced labour reallocation and capital-skill complementarity – and to disregard the traditional link which bases on the different skilled-intensity between sectors discussed above. Of course, the two channels are not in contradiction. Second, and related to the previous point, the effect highlighted in this paper is at work in any economy experiencing a trade liberalisation process, independently of its level of development. Indeed, our results can offer a complementary explanation to the puzzle of increasing wage inequality in both DCs and LDCs which follows trade integration.

[4]Bresnahan and Trajtenberg (1995) coined the term 'general purpose technologies' (GPT) to describe certain drastic innovations (e.g. computers) that have the potential for pervasive use and application in a wide range of sectors in the economy.

[5]See Devillanova (2004) for a detailed discussion on this point and for further references.

2.3 The model

We consider a small economy populated by a fixed number of skilled and unskilled workers, who supply their labor services in a competitive labor market. There are two sectors, x and y, each producing a single good, which is sold in a competitive good market. Production requires both types of labor and capital, which is supplied in a perfectly integrated international capital market at the fixed world interest rate. None of the agents in the economy can save[6]: this simplifying assumption is innocuous given our focus on wage inequality and the hypothesis of fixed interest rate. Skilled and unskilled workers can move across sectors, but they cannot migrate abroad. We introduce workers' heterogeneity adopting a production technology which exhibits capital-skill complementarity and by allowing the mobility cost to differ between skill categories. We next detail the production technology and the workers/consumer choice.

2.3.1 Production

In each sector a representative firm produces a single good $Q = \{X, Y\}$ using the following neoclassical production function:

$$Q = f(L_q, H_q, K_q) = z_q \left[b (K_q)^{\alpha} + (1-b) (L_q)^{\alpha}\right] [H_q]^{1-\alpha} \tag{1}$$

where Q is the quantity of good produced, $q = \{x, y\}$ is an index for the sector, K_q, L_q and H_q are, respectively, the quantities of physical capital, unskilled labor and skilled labor used to produce Q, α, $b \in [0, 1]$ are constants and z_q is a multiplicative parameter capturing the different productivities in the two sectors.

The production function (1) captures in a very convenient way the presence of capital skill complementarity. Indeed, the elasticity of substitution between capital and unskilled labor is $\frac{1}{1-\alpha}$, which, for $\alpha > 0$, is greater than the elasticity of substitution between capital and skilled labour, which is one. An easy to verify implication of capital skill complementarity is that $\frac{\partial \pi_q}{\partial K_q} > 0$, where $\pi_q = \frac{f_{H,q}(L_q, H_q, K_q)}{f_{L,q}(L_q, H_q, K_q)}$ is the *skill-premium* - the ratio of skilled to unskilled workers' productivity - in sector q and where $f_{H,q} = \frac{\partial f(L_q, H_q, K_q)}{\partial H_q}$ and $f_{L,q} = \frac{\partial f(L_q, H_q, K_q)}{\partial L_q}$ are, respectively, the marginal productivity of skilled and unskilled workers in sector q. In words, the more capital is employed in a sector, the higher in that sector is the marginal productivity of skilled workers relative to the marginal productivity of unskilled workers.

Two other features of this framework are worth to be emphasized. First, in (1)

[6] One might think of a third type of agents, not modeled in the paper, holding capital.

skilled and unskilled labor are complementary production factors, with elasticity of substitution equal to one. Therefore, the marginal productivity of unskilled workers is going to be positively affected by the amount of skilled workers in the sector, and vice versa. Second, the production function is the same in both sectors, apart from the multiplicative parameter z_q, and the skilled/unskilled intensity in the two sectors is going to be endogenously determined at equilibrium.

2.3.2 Workers

The economy is populated by a continuum of skilled workers of measure $\bar{H}$ and by a continuum of unskilled workers of measure $\bar{L}$. Agents inelastically supply their time endowment, which is normalized to one, in a competitive labor market.

All agents have identical preferences, represented by the following constant elasticity of substitution (CES) utility function:

$$U\left(C_x, C_y\right) = U\left(\left[\gamma C_x^{\frac{\theta-1}{\theta}} + \left(1-\gamma\right) C_y^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}\right) \tag{2}$$

where C_x and C_y denote individual's consumption of the two goods, $\gamma \in [0,1]$ and $\theta \in [0,\infty]$ determines the elasticity of substitution between goods. Agents maximize (2) by choosing how much to consume and in which sector to work. Both types of workers can move across sectors bearing some costs of reallocation; they cannot internationally migrate.

The indirect utility function is:

$$V_{j,q}\left(p_x, p_y, m\right) = \left[\gamma^{\theta} p_x^{1-\theta} + \left(1-\gamma\right)^{\theta} p_y^{1-\theta}\right]^{\frac{1}{\theta-1}} m_{j,q} \tag{3}$$

where p_x and p_y are respectively the price of good X and good Y, $j = H, L$ is an index of qualification and $m_{j,q}$ is the consumer's disposable income, which varies across sectors and qualifications. Equation (3) makes it evident that, for given prices, indirect utility is increasing in $m_{j,q}$. Each agent chooses to work in the sector that allows for obtaining the highest disposable income. If an agent changes sector, he/she pays a mobility cost, allowed to differ between skilled and unskilled workers[7]. An agent will choose to move from sector x to sector y if:

$$w_{j,y} - c_j \geq w_{j,x} \tag{4}$$

where $w_{j,q}$ is the wage of type j labor in sector q and c_j is the individual's moving

[7]Disposable income is going to depend on the public training system too, which will be introduced in the next section.

cost[8]. Reallocation of workers occurs until (4) holds with equality. Notice that, if moving were costless, wage equalization between the two sectors would be reached for each type of worker. The generic expression for c_j is:

$$c_j = f_j + \xi M_j \tag{5}$$

where M_j, is the number of movers of qualification j. The component ξM_j captures the costs of congestion associated to labor mobility, with $\xi > 0$. In particular (5) implies an aggregate mobility cost which is quadratic in M_j. In our framework, a marginal cost increasing in M_j is needed in order to get an interior solution for the free trade regime. $f_j > 0$ represents the fixed costs of mobility due to the imperfect adaptability of skills. We assume $f_L > f_H = 0$, capturing the idea that in contemporary economies skilled workers possess more general skills that can be easily reallocated in different tasks, as discussed in Section 2.

2.3.3 Equilibrium

Equating the marginal productivity of capital in each sector to the world interest rate, solving for the quantity of capital and substituting into (1), we get:

$$Q = f(H_q; L_q; z_q) = z_q^{\frac{1}{1-\alpha}} p_q^{\frac{\alpha}{1-\alpha}} b \left(\frac{\alpha b}{\overline{r}}\right)^{\frac{\alpha}{1-\alpha}} H_q + z_q (1-b) L_q^{\alpha} H_q^{1-\alpha} \tag{6}$$

Notice that, *ceteris paribus*, an increase in z_q and/or p_q, attracts new investment in the sector, increases physical production and affects, via capital-skill complementarity, the relative marginal productivity of skilled and unskilled workers in the sector.

Competitive wages of skilled and unskilled workers are:

$$w_{H,q} = p_q \frac{\partial f(H_q; L_q; z)}{\partial H_q} = z_q^{\frac{1}{1-\alpha}} p_q^{\frac{1}{1-\alpha}} d + z_q g l_q^{-\alpha} \tag{7}$$

$$w_{L,q} = p_q \frac{\partial f(H_q; L_q; z)}{\partial L_q} = p_q z_q \varphi l_q^{1-\alpha} \tag{8}$$

where $d = b\left(\frac{\alpha b}{\overline{r}}\right)^{\frac{\alpha}{1-\alpha}}$, $g = (1-\alpha)(1-b)$ and $\varphi = \alpha(1-b)$ are positive constants and $l_q = \frac{H_q}{L_q}$ indicates the skill intensity in the sector, determined by the mobility choices of workers: the higher this ratio, the more skilled labor is employed in a sector relatively

[8]For each category of workers, mobility costs are symmetrical between sectors, i.e. the cost of moving from sector x to sector y is equal to the cost of moving from sector y to sector x.

to unskilled labor. Full employment implies::

$$H_x + H_y = \bar{H} \tag{9}$$
$$L_x + L_y = \bar{L} \tag{10}$$

Normalizing $p_x = 1$, and indicating with $p = \frac{p_y}{p_x}$ the relative price of commodity Y, the equilibrium of the economy determines the set of wages ($w_{H,y},\ w_{H,x},\ w_{L,y}$ and $w_{L,x}$), the commodity price p and a distribution of workers between sectors ($H_x,\ H_y,\ L_x$ and L_y) such that workers/consumers optimally take their consumption and location decisions, firms maximize profits and markets clear.

Notice that, from (9) and (10), H_y and L_y uniquely determine the distribution of workers between sectors. Thus we are left with a system of seven unknown endogenous variable ($w_{H,y},\ w_{H,x},\ w_{L,y}, w_{L,x},\ \ p,\ H_y$ and L_y). Given p, the four equations for wages (7) and (8), $q = x,\ y$, and the two conditions for migration (4), $j = H, L$, determine wages and the workers' distribution.

In order to solve for the equilibrium, we have to distinguish between autarky and free trade.

Autarky In absence of international trade, p is determined by market clearing conditions in the commodity markets - i.e. aggregate consumption of good q, $\widetilde{C}_q$, equals production in sector q. By the properties of the CES utility function we get:

$$p_A = \frac{p_y}{p_x} = \frac{1-\gamma}{\gamma}\left(\frac{\widetilde{C}_y}{\widetilde{C}_x}\right)^{-\frac{1}{\theta}} = \left(\frac{1-\gamma}{\gamma}\right)\left[\frac{z^{\frac{1}{1-\alpha}} p_A^{\frac{\alpha}{1-\alpha}} b\left(\frac{\alpha b}{\bar{r}}\right)^{\frac{\alpha}{1-\alpha}} H_y + z\left(1-b\right) L_y^{\alpha} H_y^{1-\alpha}}{b\left(\frac{\alpha b}{\bar{r}}\right)^{\frac{\alpha}{1-\alpha}} H_x + \left(1-b\right) L_x^{\alpha} H_x^{1-\alpha}}\right]^{-\frac{1}{\theta}} \tag{11}$$

where the subscript A indicates autarky.

Free trade Under the assumption of small economy, in free trade the relative price p_{FT} is determined in the international market and it is now *exogenous*. We assume that $p_{FT} > p_A$, implying that Home country has a comparative advantage in sector y.

2.3.4 Public training program

We also model a public re-training program, intended at reducing the mobility cost of unskilled workers, financed by a proportional tax levied on skilled workers. Specifically, we assume that the training expenditures are targeted to all unskilled workers in the

sector with comparative disadvantage and that they reduce the fixed component of their mobility cost. The relevant cost for unskilled workers becomes:

$$\widetilde{c}_L = f_L - \chi e + \xi M_L \tag{12}$$

where e indicates per capita training expenditures and χ is a parameter capturing the effectiveness of the program. The idea behind (12) is that if workers' reallocation cost is affected by the adaptability of their skills - which, in our simplified framework, maps into the distinction between skilled and unskilled workers - it can be reduced by programs aimed at providing more adaptable skills[9]. Just as an example, one can think of f_L as the cost of a course to learn a computer package. If $\chi = 1$, our benchmark case, one euro expenditures in training causes one euro reduction in the individual's reallocation costs, just as it where a voucher covering part of the fee of the course. $\chi > 1$ allows for the presence of economies of scale and/or esternalities in the provision of a public training program.

A second, interesting interpretation can be associated to the parameter χ. Few recent contributions have stressed the role of employment protection legislation (EPL) and other institutional settings in preventing labor mobility. If EPL are believed to be the only/main source of low mobility, labor reallocation could be reached by reducing job security regulations, at no cost. In our framework, this possibility can be modeled by simply assuming a perfectly effective training program, i.e. $\chi = \infty$. The idea behind our paper is that, in fact, mobility costs introduce a further important source of friction in the labour market, other than the EPL. This observation is crucial in order to evaluate the instruments available to the policy maker to enhance labour reallocation. In particular, if the adaptability of workers to new tasks is a major concern, changes in EPL would not have the expected effect; at the same time, policies aimed at increasing mobility become costly and their optimality cannot be given for granted.

The introduction of the training program requires only few marginal adjustments to the previous set-up. The relevant wage for skilled workers is now the after tax wage:

$$\widetilde{w}_{H,q} = (1-t)w_{H,q} \tag{13}$$

where t is the tax rate. Moreover, we consider a balance budget constraint for the

[9] Our analysis focuses on the short-run effects of trade integration. A long-run perspective should account for the endogeneity of the workers' education decision.

training program:

$$E = t\left[\widetilde{H}_y w_{Hy} + H_x w_{Hx} + \left(\widetilde{H}_x - H_x\right)(w_{Hy} - c_H)\right] \tag{14}$$

where E are total expenditures in training and $\widetilde{\cdot}$ denotes variables at their initial equilibrium. Once t is fixed, total expenditures are uniquely determined by (14). We assume that total expenditures are distributed equally among all the unskilled workers in the sector, hence per worker expenditure is $e = \frac{E}{\widetilde{L}_x}$, where we are using the fact that if any reallocation of workers occurs, it is going to take place from sector x to sector y.

Once we substitute (5) for unskilled workers with (12) and (7) with (13), the equilibrium of the economy is described as in Section 3.3, except that now we have one free variable t. Next we characterize the equilibrium of the economy as a function of the tax rate.

2.4 Results

In this section we study the effect of trade integration on both within and across group wage inequality, and on aggregate welfare. More specifically, we focus on four main outcomes: within group wage inequality $\frac{w_{L,y}}{w_{L,x}}$ and $\frac{w_{H,y}}{w_{H,x}}$; across group wage inequality in each sector, which, under the assumption of competitive labor market, is given by the skill premium[10] π_q; aggregate across group wage inequality – the average wage premium $\pi = \frac{(H_x+L_x)\pi_x+(H_y+L_y)\pi_y}{\overline{H}+\overline{L}}$; aggregate welfare, measured by an utilitarian social welfare function W. Notice that the choice of an utilitarian welfare function is clearly reductive, since it does not attach any disutility to inequality, but it is conservative from the point of view of our results.

To focus on essentials, we consider the case in which the two sectors have identical productivities - i.e. $z_y = z_x = 1$ - and the utility function is a Cobb-Douglas symmetric in the two goods. In this case, the autarky equilibrium relative price is $p_A = 1$, workers are distributed symmetrically between sectors, within group inequalities are null and the wage premium is the same in the two sectors. Starting from a symmetric autarky equilibrium, we can more easily concentrate on factor reallocation solely driven by free trade.

[10]Here we look at gross of taxes relative wages. See footnote 1.

2.4.1 Free Trade

Suppose now that the Home country opens to international trade. Under the assumption of small economy, with free trade the relative price is determined in the international market and is now exogenous. We assume that trade integration causes an increase in the relative price p, implying that if any reallocation of workers occurs, it is going to take place from sector x to sector y.

In this case, the aggregate utilitarian social welfare function W is:

$$W = \left[H_x V_{H,x} + \widetilde{H}_y V_{H,y}^{nc} + (\widetilde{H}_x - H_x)V_{H,y}^{nc}\right] + \left[L_x V_{Lx} + \widetilde{L}_y V_{Ly}^{nc} + \left(\widetilde{L}_y - L_x\right) V_{Ly}^{c}\right]$$

where V_j is the indirect utility function of workers of type j and the superscript n and nc denotes, respectively, movers, who bear the reallocation cost, and stayers. For instance, in the the first bracket, which refers to skilled workers, $\widetilde{H}_y V_{H,y}^{nc}$ denotes the indirect utility function of skilled workers who were in y at the initial equilibrium and who do not bear any reallocation cost; $H_x V_{H,x}$ is the indirect utility function of skilled workers who remain in x; $(\widetilde{H}_x - H_x)V_{H,y}^{nc}$ is the indirect utility function of movers.

Immobile unskilled workers

We first consider a situation in which, starting from $p_A = 1$, trade integration entails a marginal increase in p which is not sufficient to make the wage differential larger than the moving cost - i.e. $|w_{Ly} - w_{Lx}| < c_L$. In other words, the trade-induced sectoral wage differential is lower than the reallocation costs for unskilled workers in sector x. Under this assumption, the following proposition summarizes the main consequences of opening up the economy to international trade:

Proposition 1 *Free trade raises aggregate welfare and both aggregate and within group inequality. Moreover, it has an ambiguous effect on wage premium in sector y whereas it certainly increases the wage premium in sector x.*

Proof. See Appendix 1. ■

Proposition 26 points out that an increase of the relative price p due to trade integration affects all the variables of interest. In particular, it raises total output and welfare because of some reallocation of mobile factors - skilled workers and capital - toward the most profitable sector.

Trade integration also has distributional consequences. First of all, by inducing a reallocation of skilled workers from sector x to sector y, and because of the comple-

Figure 2.1: Skilled workers sector Y

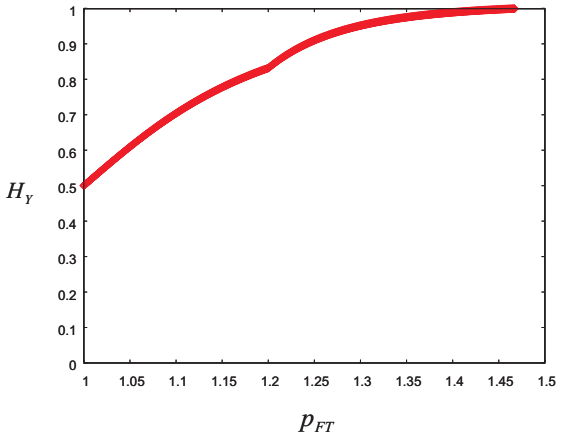
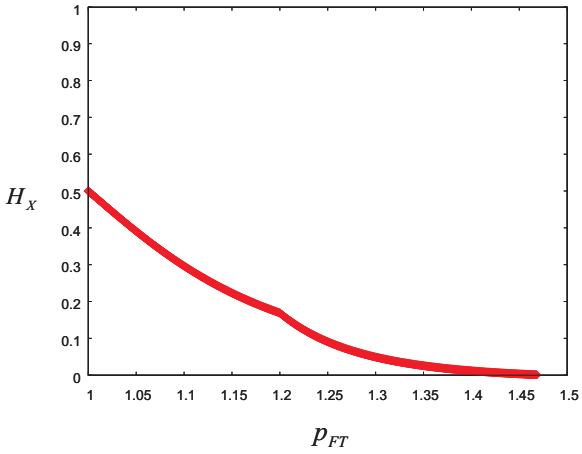


Figure 2.2: Skilled workers sector X



mentarity between the two types of labor, it increases within group wage inequality of (immobile) unskilled workers. Second, the same reallocation of skilled workers also affects the across group wage inequality in each sector, by altering the skill composition. Third, the arrival of new capital in the economy - attracted by the trade-induced sector y increased profitability - causes an increase in the average across group wage inequality, because of capital skill complementarity. The overall effect is an increase of all the proposed measures of inequality.

Mobile unskilled workers

In the more general case, when both skilled and unskilled workers are allowed to move across sectors, since the conditions characterizing the equilibrium of the economy are highly non linear, we are unable to provide a closed form solution and we have to compute numerically the model. The values of the parameters are: $b = 0.4$, $\overline{r} = 0.1$; $\alpha = 0.5$; $\xi = 0.05$; $\theta = 1$; $\gamma = 0.5$, $\overline{L} = 2$ and $\overline{H} = 1$. To facilitate the analysis of Section 4.1.4, we choose a fixed mobility cost for unskilled workers $f_L = 0.205$, such that when $p_{FT} = 1.2$ (the free trade price we use in that Section) none of them finds it optimal to move. We check the qualitative robustness of the results to all the admissible range of the parameters of the model and we only discuss this issue when results are sensitive to the parameter specification.

When the Home country opens to free trade - i.e. $p = p_{FT} > p_A = 1$ - skilled workers immediately react to the wage differential between sectors and reallocate toward sector y - see figure 2.1 and 2.2. At the same time, international mobile capital accrues

Figure 2.3: Skilled wage sector Y

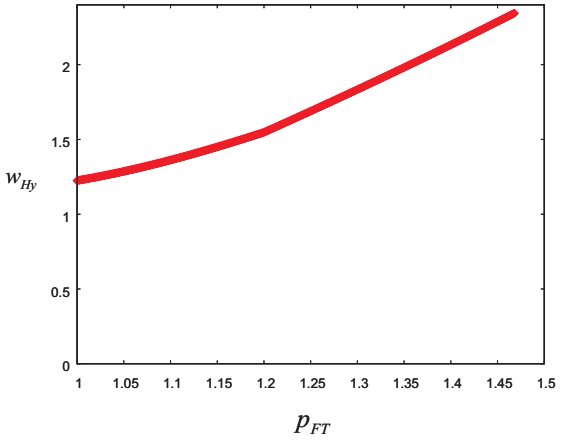
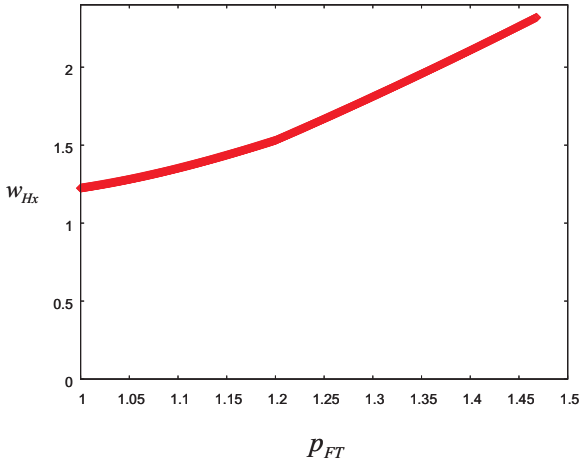


Figure 2.4: Skilled wage sector X



to sector y. The overall effect is an increase of the skilled wage in both sectors, as figure 2.3 and 2.4 make it clear. Because of reallocation costs, $\frac{w_{H,y}}{w_{H,x}}$ slightly increases – see figure 2.5. Given the level of the fixed cost f_L, unskilled workers reallocate if $p_{FT} > 1.2$ - the level of the free trade price for which equation 4 has a positive sign. For $p_{FT} = 1.469$ reallocation is complete and only sector y produces (see figure 2.6 and 2.7). The effect on within group inequality for unskilled workers is shown in figure 2.8 , where we plot $\frac{w_{L,y}}{w_{L,x}}$ associated to different levels of p_{FT}. It worth noting that within group inequality is strictly increasing in p_{FT}. For $p_{FT} < 1.2$, this is a general result, due to the complementarity between the two types of labor and to the fact that unskilled workers are fixed. For $p_{FT} > 1.2$ relative mobility of skilled and unskilled workers matters. In particular, in our numerical example at $p_{FT} = 1.2$ most skilled workers have already moved to sector y; for higher levels of p_{FT} the skill intensity l_q is smaller (figure 2.9 and 2.10) and unskilled wages is lower[11] (figure 2.11 2.12) in both sectors. Of course, within group wage inequality is not defined when the economy is fully specialised.

As aggregate across-group inequality is concerned, figure 2.15 shows that the relationship with free trade price is non monotonic. Let consider first the two limit cases. When $p_{FT} = 1$, the economy is perfectly symmetric, the sectoral skill intensities (see figures 2.9 and 2.10) and the sectoral skill-premia (see figure 2.13 and 2.14) are identical. Consider instead the level of p_{FT} such that the economy is completely specialized: the skill intensity in sector y is the same as in autarky, but, as figure 2.15

[11] Wages of unskilled workers increases in sector y if the congestion cost for skilled workers is high enough.

Figure 2.5: Skilled wage ratio

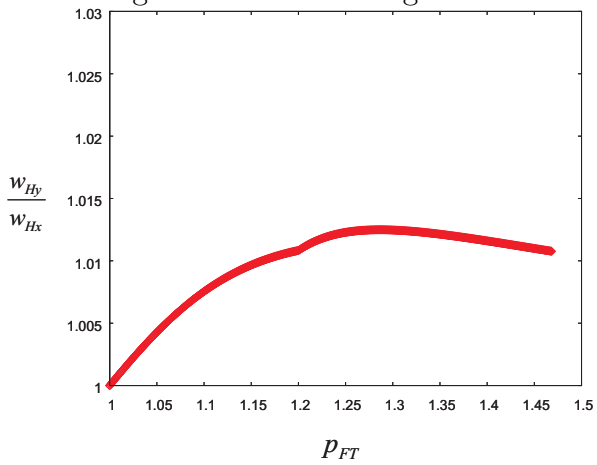


Figure 2.6: Unskilled workers sector Y

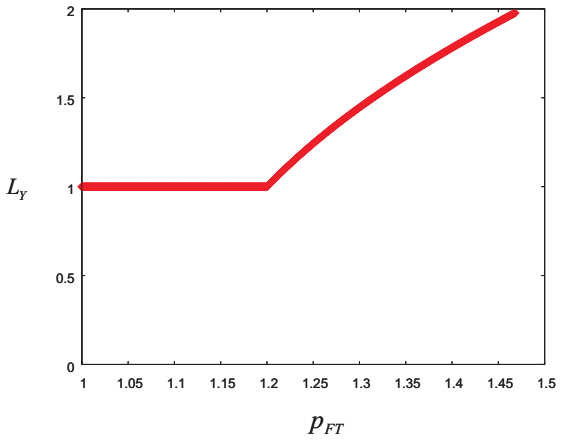


Figure 2.7: Unskilled workers sector X

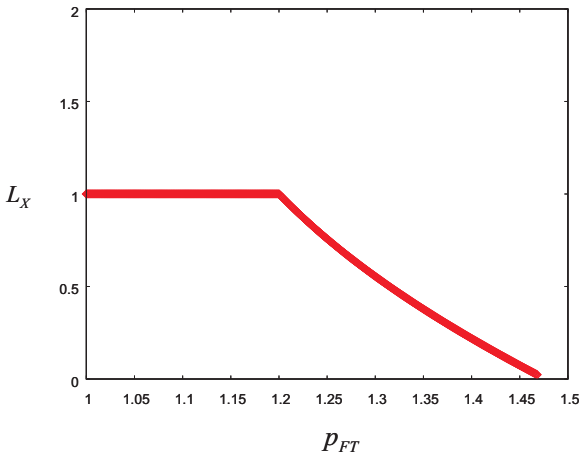


Figure 2.8: Within group inequality

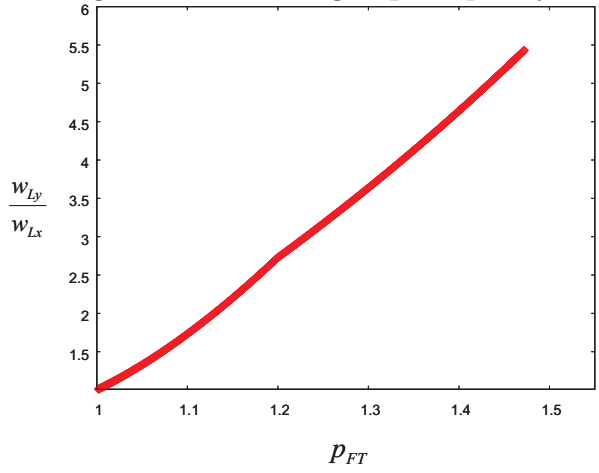


Figure 2.9: Skill intensity sector Y

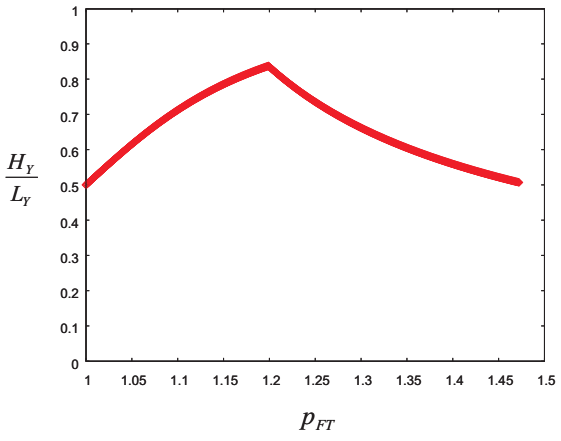


Figure 2.10: Skill intensity sector X

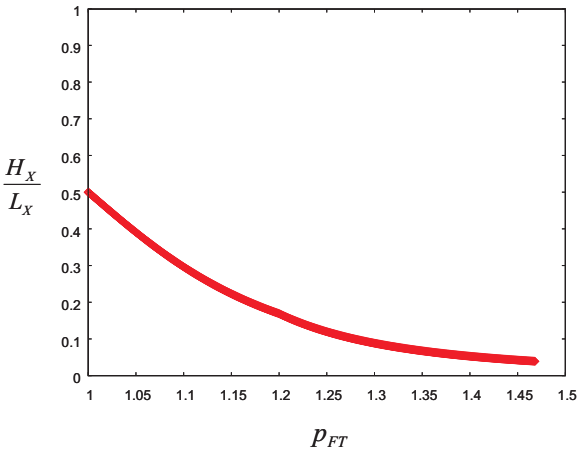


Figure 2.11: Unskilled wage sector Y

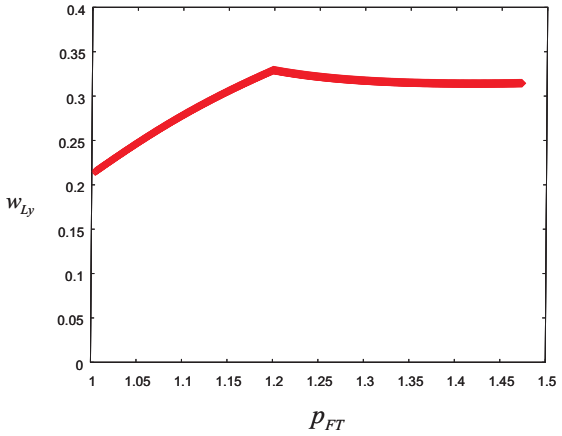


Figure 2.12: Unskilled wage sector X

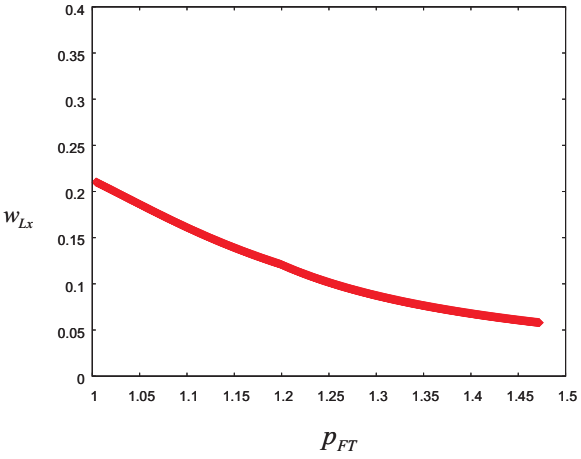


Figure 2.13: Sectoral skill premium - sector Y

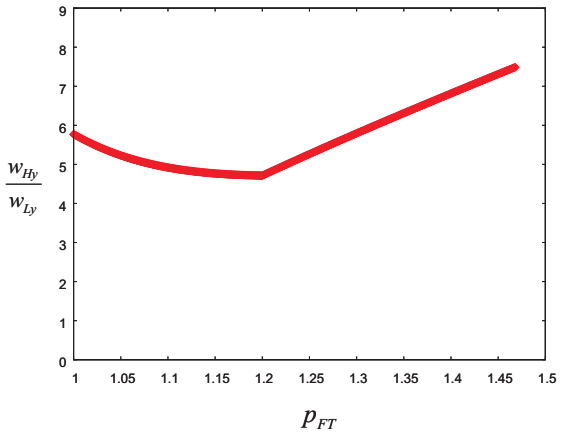


Figure 2.14: Sectoral skill premium - sector X

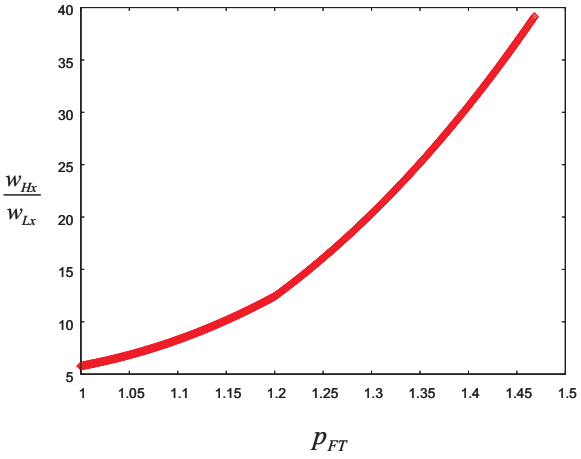
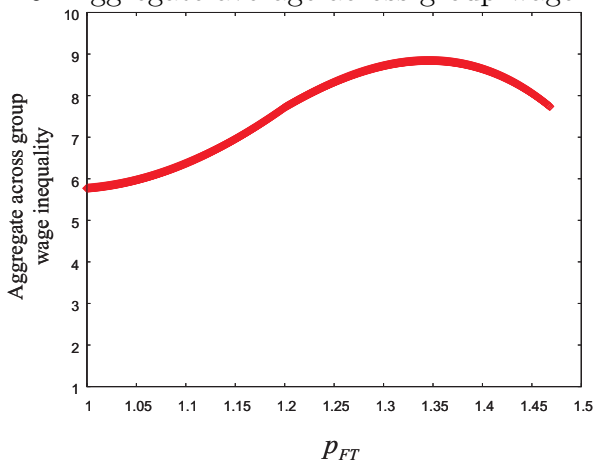


Figure 2.15: Aggregate average across group wage inequality

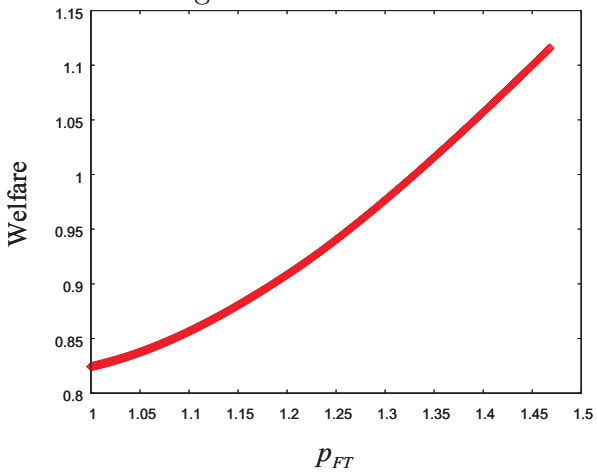


highlights, across-group wage inequality is now higher. This is due to capital-skill complementarity: namely, a higher p_{FT} attracts more capital in the economy, rising the skill premium; when the economy specializes in production of Y, this unambiguously rises across-group inequality in that sector. The behaviour of aggregate across-group wage inequality in between these two extreme points is more tricky to be analysed. Let we first focus on sector x. By figure 2.10, skill intensity in the sector x decreases, unambiguously increasing the wage premium in the sector. In sector y two forces are at work: the (non monotonic) behaviour of the skill intensity in the sector, which should first reduce and then increase the skill premium; the arrival of new capital, which, by capital-skill complementarity, rises the wage premium. The net effect of these two forces on wage inequality in y is plotted in figure 2.13. The average wage premium captures both the behaviour of (the level of) wage inequality in x and y and changes in the relative weights of the two sectors. In particular, for p_{FT} that assumes values between 1 and 1.2, the dramatic increase in wage inequality in x more than compensate the reduction of wage inequality in y. For higher values of p_{FT}, inequality increases in sector y too. However, factor reallocation progressively lowers the weight of sector x in determining aggregate wage inequality. The latter reaches a maximum at $p_{FT} = 1.346$ and is lower for higher values of the free trade price. Remarkably, average across-group wage inequality is always higher in free trade with respect to autarky.

Notice, finally, that aggregate welfare increases with p_{FT} (figure 2.16). Indeed an higher p_{FT} implies that more (international) capital enters sector y. At the same time, the higher the free trade price, the higher the incentive to specialize in order to exploitation the comparative advantage of the country.

Summing up, the analysis of this section shows that the trade liberalisation causes

Figure 2.16: Welfare



an increase in aggregate welfare, but also an increase in across and within group wage inequality. We next study the effect of the reallocation cost on these variables.

The effect of fixed cost

We now study the equilibrium of the model when, for given p_{FT} we let the mobility costs of unskilled workers to vary and we study how the level of the fixed cost f_L affects the variables of interest of our model.

We consider a free trade relative price $p_{FT} = 1.2$. For $f_L > 0.205$ unskilled workers do not move because within group wage differential is lower than the fixed cost f_L (the constant horizontal interval figure 2.17 and 2.18). When $w_{Ly} - w_{Lx} > f_L$ some unskilled workers in x move toward sector y. Skilled workers and capital follow the reallocation of unskilled workers toward sector y. Figure 2.19 shows the effect of f_L on the within group inequality. The graph stops when all workers to be reallocated in sector y. As figure 2.19 illustrates, the lower f_L, the lower the within group inequality in equilibrium. It is worth stressing that this result is due to the complementarity between skilled and unskilled workers. The second important result is that a lower fixed cost f_L implies a lower aggregate wage inequality (figure 2.20). The intuition of this result is that, for given p_{FT}, with lower f_L unskilled workers can move from a highly unequal sector to a less unequal sector (see figure 2.21 and 2.22). Notice that sectoral inequality is driven, among other factors, by the skill intensities (see figure 2.23 and 2.24), whose behaviour depends, as we have already stressed, by the particular value of mobility cost. Notice also that, specularly to the case analysed in the previous section, the emergence of lower aggregate wage inequality when fixed cost are lower

Figure 2.17: Unskilled workers sector Y

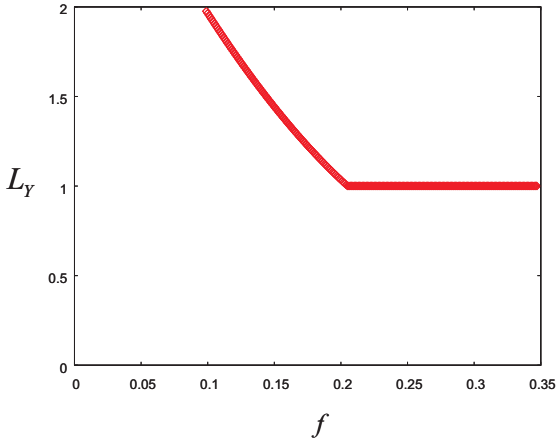


Figure 2.18: Unskilled workers sector X

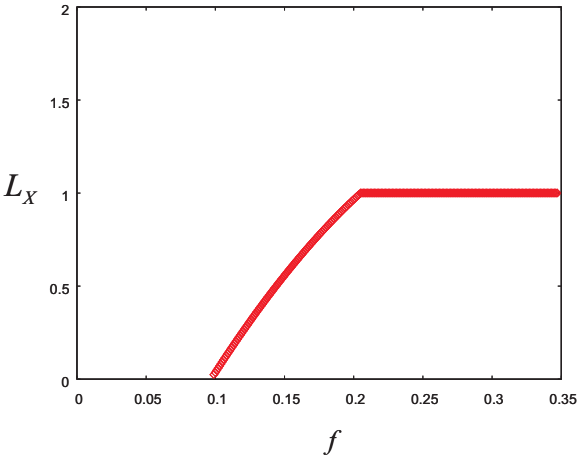


Figure 2.19: Within group inequality

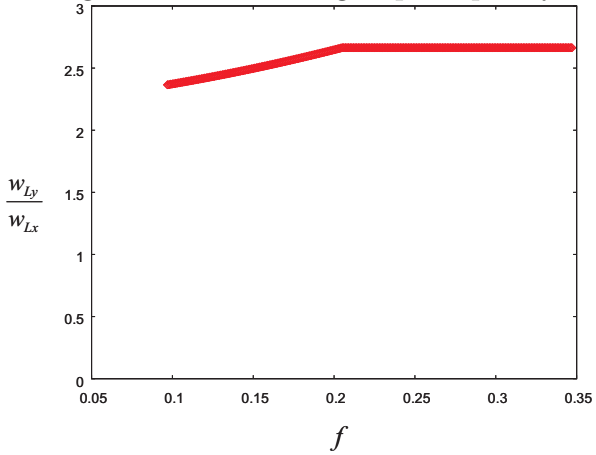


Figure 2.20: Aggregate average across group wage inequality

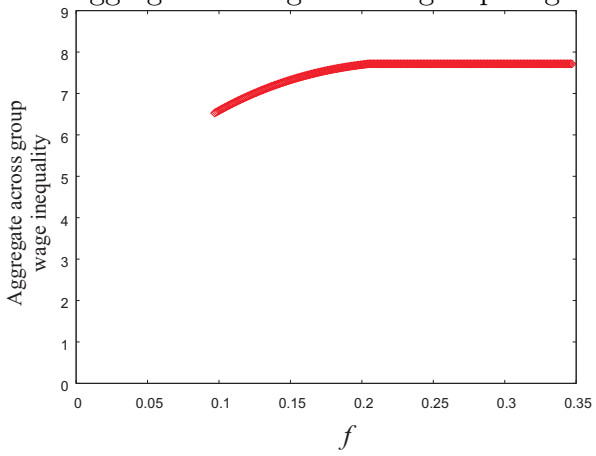


Figure 2.21: Inequality sector Y

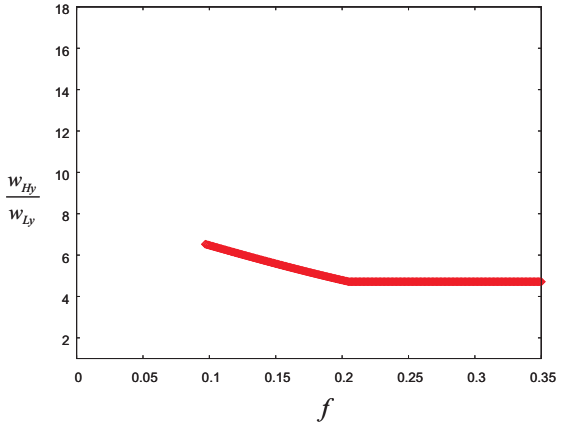
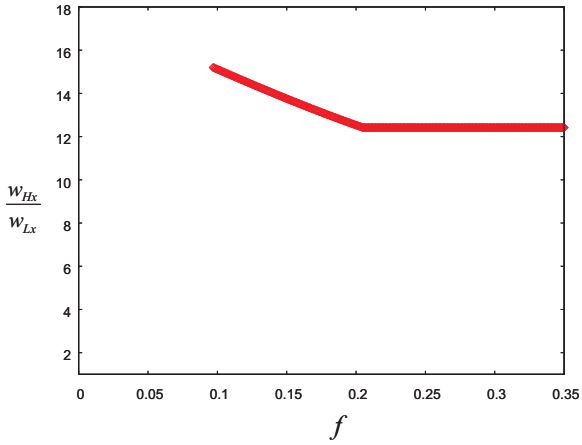


Figure 2.22: Inequality sector X



is accompanied by higher wage premium in both sectors. This result highlights how mobility costs for unskilled workers represent a further factor fostering the increase in wage premium induced by the presence of capital-skill complementarity during the reallocation process[12]. The third result is that when f_L is lower, aggregate welfare is higher (see figure 2.25). The reason is, trivially, that the moving cost represents a waste of resources in the aggregate and limit the profitability of the reallocation of the production factors. This means that the lower these costs are, the more a country can exploit its comparative advantages.

Taxation and the retraining program

The previous sections highlights that: i) trade integration increases welfare and both across and within group wage inequality; ii) a lower unskilled workers' mobility cost reduces both across and within group wage inequality. Here we explore the possibility of using (part of) the welfare gain of trade integration in order to reduce inequality, by reducing unskilled workers mobility cost[13]. In particular, we introduce a re-training

[12]Moreover it is possible to show that the degree of capital-skill complementarity (captured by the parameter alpha) affects not only the level of between-group inequality, but also the degree of within group-inequality.

[13]There exists a vast literature on Pareto gains from trade, which looks at the possibility compensating those who lose from free trade using public redistribution in the presence of informational constraints. – see Facchini and Willmann (2001) and references therein. Here we abstract for asymmetric information. This simplification is partly justified by the fact that the policy instrument we study is a program which provides each worker in the low-wage sector with training that reduces individual's mobility cost. We thus exclude money transfers and targeting on individual's observable characteristics.

Figure 2.23: Skill intensity sector Y

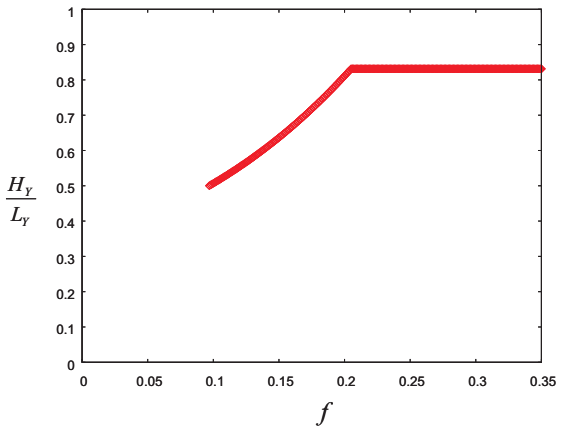


Figure 2.24: Skill intensity sector X

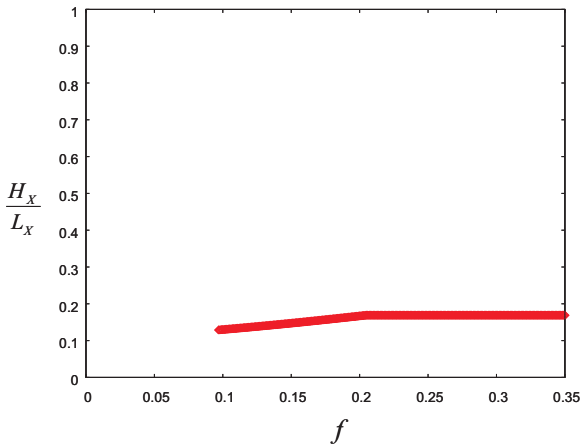


Figure 2.25: Welfare

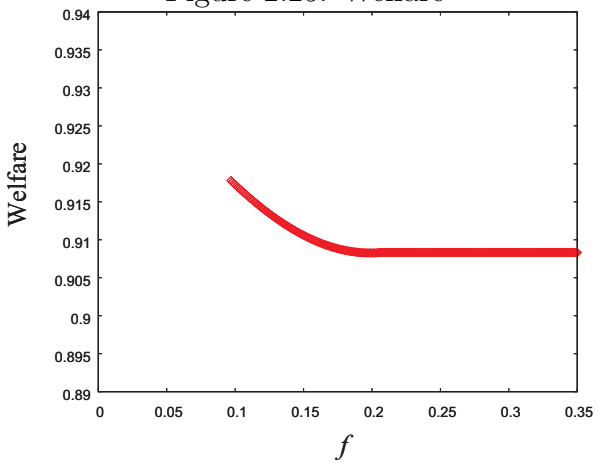


Figure 2.26: Within group inequality

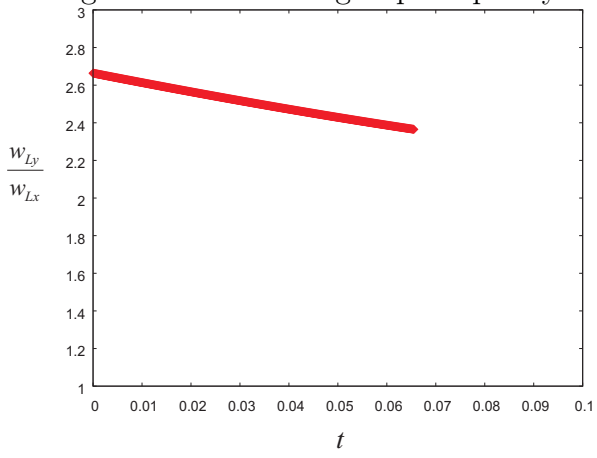
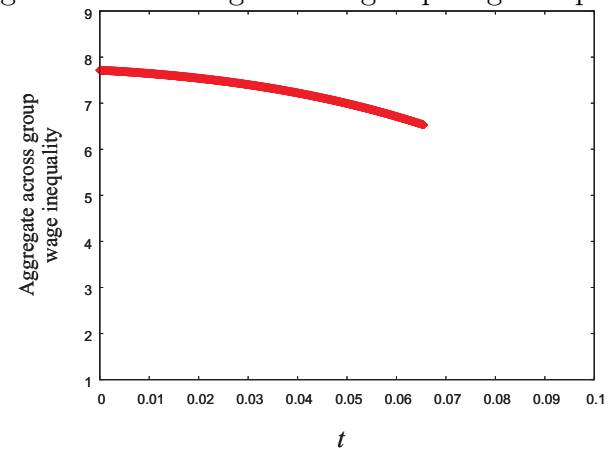


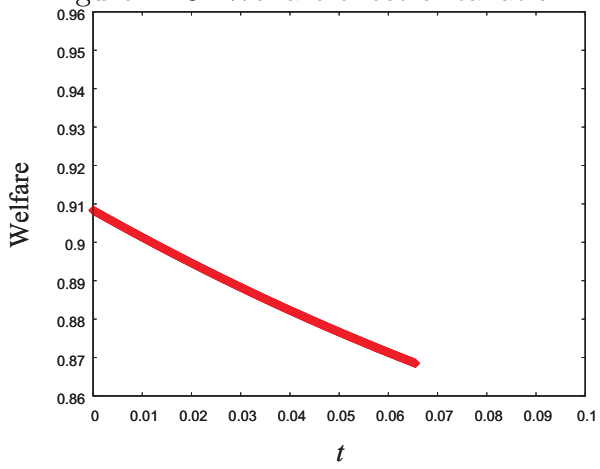
Figure 2.27: Average across group wage inequality



program for unskilled workers in sector x, financed by a flat tax on skilled wages. As before, we fix $p_{FT} = 1.2$ and consider a situation in which, with no training program, unskilled workers would never move ($f_L = 0.205$). It follows that, for $t = 0$, unskilled workers are equally allocated in the two sectors (i.e. $\widetilde{L}_x = \widetilde{L}_y = 1$). Obviously, skilled workers are unevenly distributed between sectors, since they have no fixed mobility cost. For the moment we will consider a low efficiency of the re-training program, i.e. $\chi = 1$.

Not surprisingly, the effects on wage inequality of an increase in t mimic the ones illustrated in the previous section. Indeed, from (12) and (14) it is evident that, given $\widetilde{L}_x = 1$, a higher tax rate implies a lower reallocation cost for unskilled workers. In particular, we find that both within and across group wage inequality are decreasing in t (see figure 2.26 and 2.27). Differently from the case of an exogenous reduction of f_L, aggregate welfare decreases as t increases, since the reduction of friction to mobility is now costly - see figure 2.28. When the re-training program shows low efficiency - $\chi = 1$ - the latter effect more than compensates the positive effect of factor reallocation on

Figure 2.28: Welfare effect of taxation



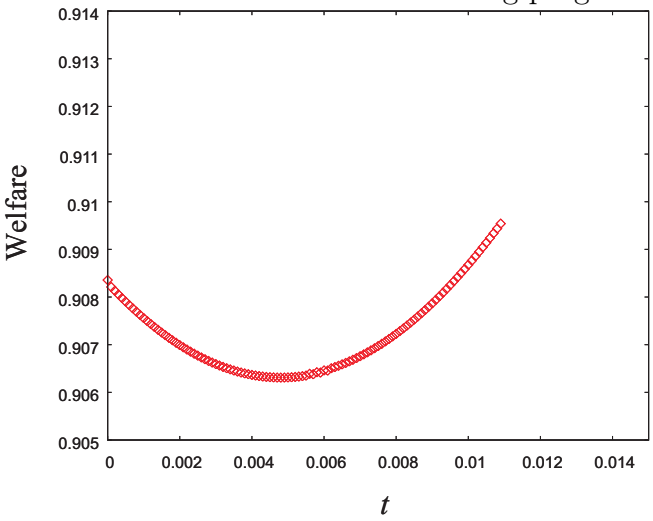
efficiency. We come back to this point later. We are in the presence of a trade-off: the re-training program reduces inequality but at the same time decreases aggregate welfare.

Table 2.1: **Pareto Gains from trade**

	autarky	Free trade $t = 0$	Free trade $t = 0.66$ *(full reallocation)*	Free trade $t = 0.141$	Free trade $t = 0.155$
Welfare	0.824	0.908	0.868	0.868	0.868
Utility skilled in Y	0.612	0.706	0.708	0.650	0.640
Utility skilled in X/movers	0.612	0.698	0.697	0.640	0.630
Utility unskilled in Y	0.106	0.150	0.116	0.116	0.116
Utility unskilled in X/movers	0.106	0.056	0.049	0.106	0.116

Is it possible to exploit the welfare gain induced by trade integration in order to make all agents better off? In order to answer this question, table 2.1 compares the autarky equilibrium with the free trade one. The first two columns show that, when $t = 0$, trade integration has a positive effect on aggregate welfare, but it hurts unskilled workers in sector x. For $t = 6.6\%$ all workers reallocate to sector y and the economy is fully specialised. However, unskilled movers would have been better off in autarky. If, however, we further increase t, unskilled workers indirect utility can be increased, by reducing their fixed mobility cost. In particular, given our parameters, a level of taxation higher than $t = 14.1\%$ allows to obtain an equilibrium which is Pareto superior to the autarky one. In sum, even when the public re-training program entails some welfare losses, it can make trade integration Pareto improving. Notice

Figure 2.29: Welfare effect of the re-training program - $\chi = 6$



that, from the point in which the economy is completely specialized changes in t have no effect on the aggregate welfare, because now the retraining program acts simply as an (indirect) redistributive mechanism. Notice, finally, that the condition $E \leq f_L$ is always satisfied. The last column of table 2.1 ($t = 0.155$) consider the case where e fully covers the unskilled workers' mobility cost.

Finally, figure 2.29 illustrates the situation in which $\chi > 1$. As we discussed in Section 2.3.4, different interpretations can be attached to this case: increasing returns of the re-training program[14], some form of externality, the possibility of increasing mobility by costless changes in EPL. In all these instances, one euro used to finance the re-training mechanism allows for obtaining more than one euro exploiting the comparative advantage of the economy. When this happens, it is possible for the tax/training program to produce a welfare enhancing effect. For instance, with $\chi = 6$, welfare increases with respect to free trade with no training program for $t > 0.0096$ and with $t = 0.011$ total reallocation is reached and welfare is maximised.

As a final remark, notice that the interaction between labor mobility and wage inequality explored in this paper is at work also in closed economies. This observation seems to suggest the opportunity of a re-training mechanism in closed economy too[15]. However, in autarky the optimality of such a program is jeopardized by two considera-

[14]One can also think to programs targeted to reduce the mobility cost of those unskilled workers who actually move.

[15]The analysis of autarky - available upon request - is similar to the one developed in this paper: the only difference is the abandon the assumption of equal productivity in the two sectors, with now z_q playing the role of p_{FT} in driving individuals' mobility decisions.

tions. First, prices are now endogenously determined by (11). It follows that a positive productivity shock to, for instance, sector y, by increasing the relative supply of Y, reduces the relative price p_{FT}. The magnitude of the price effect crucially depends on the elasticity of substitution in the utility function – which plays no role in the case of free trade. In other words, the scope for labor reallocation is lower in closed economy. Second, as we have already noticed, apart from the case of very efficient re-training program, $t > 0$ entails some welfare losses. In the absence of a welfare gain induced by trade integration, the trade-off equity/efficiency becomes more stringent and no Pareto superior policy is available.

2.5 Conclusions

The discussion over welfare and distributional effects of trade integration is by now a long standing one. In this paper we suggest a new channel through which trade integration can affect these variables, which relies on the heterogeneity between skill categories. In particular, we allow the mobility cost to differ between skill categories, and we adopt a production technology which exhibits capital-skill complementarity. We also study the role of a costly re-training program, intended at reducing individuals' intersectoral mobility costs, in shaping the effects of trade integration

Two are the main contributions of our study. First, the model proposed here is able to account for the effect of trade integration on both across and within skill categories wage inequality when workers are (imperfectly) inter-sectorally mobile. This is, to the best of our knowledge, new to the literature. Notice, incidentally, that the redistributional effect of integration may cause a lack of political consensus for trade liberalisation, preventing the country to benefit from the the gains accruing from international specialization. Second, we show that even under the conservative assumption of a re-training program entailing some welfare losses, its implementation can make trade integration Pareto improving.

This papers enters the debate about the redistributive effects of trade liberalization. How is it possible to profit gains from trade without fostering inequalities and making someone worse off? Generally the policies suggested to face this issue consists in some transfer scheme for the losers - see Davidson and Matusz (2005) and the literature cited there - in the spirit of the Samuelson compensation principle: the winners gain enough from liberalization to fully compensate the losers without exhausting all of their gains. In this paper we instead focus our attention on the labour market and in particular on the rigidities due to the imperfect adaptability of the skills of workers. Our main point is that the (partial) immobility of workers represents not only a possible source

of inefficiency (indeed it may limit the profitability of comparative advantage), but it also constitutes a major reason of inequality in the distribution of the gains from trade. In this perspective, a training program can be able, under certain conditions, to reduce inequality, foster efficiency and compensate the losers of free trade.

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Appendix 1

Proof of Proposition 1

We begin showing that free trade increases the with-in group inequality. Given the full mobility of skilled workers and the full immobility of unskilled workers, in equilibrium it must be that: $w_{HY} = w_{HX}$ and $L_Y = L_X = 1$. From equation (7), in equilibrium it holds that:

$$(p_y)^{\frac{1}{1-\alpha}} d + p_y g \left(H_Y\right)^{-\alpha} = d + g \left(H_X\right)^{-\alpha}$$

Since $p_y > 1$, this equality is satisfied if and only if $H_Y > H_X$, which also implies that skill-intensity in sector y is higher than in sector x. It follows that

$$w_{LY} = p_y \varphi H_Y^{1-\alpha} > w_{LX} = \varphi H_X^{1-\alpha}$$

i.e. that the within-group inequality in the unskilled category is increased with respect to the autarky case (where $w_{LY} = w_{LX}$).

Let now consider the effect of trade integration on the aggregate wage inequality. Aggregate inequality is defined as:

$$\bar{w}_p = \frac{\frac{w_{HY} H_Y + w_{HX} H_X}{H_Y + H_X}}{\frac{w_{LY} L_Y + w_{LX} L_X}{L_Y + L_X}} = \frac{2\left[d + g\left(1 - H_Y\right)^{-\alpha}\right]}{p_y q H_Y^{1-\alpha} + q\left(1 - H_Y\right)^{1-\alpha}}$$

In order to evaluate the effect of the opening to free trade on the aggregate wage inequality it is sufficient to study the sign of the first derivative of $\bar{w}_p$ with respect to p_y calculated in $p_y = 1$. The first derivative is:

$$\frac{\partial \bar{w}_p}{\partial p_y} = \frac{\left[2\alpha g \left(1 - H_Y\right)^{-\alpha-1} H_Y'\right]\left(p_y q H_Y^{1-\alpha} + q\left(1 - H_Y\right)^{1-\alpha}\right)}{\left[p_y q H_Y^{1-\alpha} + q\left(1 - H_Y\right)^{1-\alpha}\right]^2} +$$
$$+ \frac{-2\left[d + g\left(1 - H_Y\right)^{-\alpha}\right]\left[q H_y^{1-\alpha} + p_y q\left(1-\alpha\right) H_Y^{-\alpha} H_Y' + \left(1-\alpha\right) q \left(1 - H_Y\right)^{-\alpha}\left(-1\right) H_Y'\right]}{\left[p_y q H_Y^{1-\alpha} + q\left(1 - H_Y\right)^{1-\alpha}\right]^2} \quad (15)$$

Now we study the sign of (15) in $p_y = 1$, where $H_Y = H_X = \frac{1}{2} = \bar{H}$. Since the denominator of (15) the previous is always positive, the sign of the derivative is fully

determined by the sign of the numerator:

$$\begin{aligned}\left\{\frac{\partial \bar{w}_p}{\partial p_y}\right\} &= \left[2\alpha g H_Y^{-\alpha-1} H_Y^{'}\right]\left(qH_Y^{1-\alpha}+qH_Y^{1-\alpha}\right)+ \\ &\quad -2\left[d+gH_Y^{-\alpha}\right]\left[qH_y^{1-\alpha}+q\left(1-\alpha\right)H_Y^{-\alpha}H_Y^{'}+\left(1-\alpha\right)qH_Y^{-\alpha}\left(-1\right)H_Y^{'}\right] \\ &= \left[2\alpha g H_Y^{-\alpha-1} H_Y^{'}\right]2qH_Y^{1-\alpha}-2\left[d+gH_Y^{-\alpha}\right]qH_y^{1-\alpha}\end{aligned}$$

Simplifiyng we obtain:

$$\frac{\partial \bar{w}_p}{\partial p_y} = 4\alpha gqH^{-2\alpha}H^{'}-2dqH^{1-\alpha}-2gqH \tag{16}$$

Substituting into (16) the first derivative of H with respect to p_y in $\bar{H}$, we obtain:

$$\begin{aligned}\frac{\partial \bar{w}_p}{\partial p_y} &= 4\alpha g\frac{\frac{1}{1-\alpha}d+g\bar{H}^{-\alpha}}{\alpha g\left[\bar{H}^{-\alpha-1}+\bar{H}^{-\alpha-1}\right]}\bar{H}^{-2\alpha}-2d\bar{H}^{1-\alpha}-2g\bar{H} \\ &= \bar{H}^{1-\alpha}\left(\frac{1}{1-\alpha}d+g\bar{H}^{-\alpha}\right)-d\bar{H}^{1-\alpha}-g\bar{H} \\ &= \bar{H}^{1-\alpha}\frac{1}{1-\alpha}d+g\bar{H}^{1-2\alpha}-d\bar{H}^{1-\alpha}-g\bar{H} \\ &= g\bar{H}\left(\bar{H}^{-2\alpha}-1\right)+d\bar{H}^{1-\alpha}\left(\frac{1}{1-\alpha}-1\right) \\ &= g\bar{H}\left(\frac{1}{\bar{H}^{2\alpha}}-1\right)+d\bar{H}^{1-\alpha}\left(\frac{\alpha}{1-\alpha}\right)>0\end{aligned}$$

since $0<\alpha<1$. This proves that, starting from a situation of perfect symmetry among the two sectors, an increase in the relative price p_y makes the aggregate income inequality to increase.

Chapter 3

Uncertainty, Gains from Specialization and the Welfare State

3.1 Introduction

The first mantra of trade theory is that free trade is always superior to autarky. This result derives directly from the application of the cornerstone of classical trade theory: the principle of comparative advantage. The story is well known: opening up to free trade induces a reallocation of production factors that, increasing productivity and reducing prices, increases aggregate real incomes. The trade-induced specialization process is *good* because it allows the exploitation of the country's comparative advantages. It can also be easily shown that the gains from trade are higher the more different is the free trade specialization equilibrium from the autarky one. Thus, in the simple and predictable world of standard trade theory, free trade is always optimal and the more the country specializes the better it is. This paper shows that under uncertainty this not more true.

As it is well known, under uncertainty most of the standard trade theorems are not valid and trade patterns are not expected to follow comparative advantages (Hoff, 1994). Under uncertainty is also possible that autarky becomes better than free trade (Newbery and Stiglitz, 1984). Furthermore, when agents are risk averse, there are several instances in which government intervention, contrary to the standard case, is welfare increasing also in a trade context. This latter literature has been pioneered by Eaton and Grossman (1985), in which it is consider a small open economy facing uncertain terms of trade and where markets for contingent claims are incomplete. It

is shown that in this case free trade is not optimal and that government can improve aggregate welfare by using commercial policy (i.e. tariffs on imports) that serves as a partial substitute for missing insurance markets[1]. But government intervention can also have a positive impact on welfare through the modification of the pattern or level of specialization. For instance, Brainard (1991) discusses the role of government intervention in inducing the optimal level of specialization when human-capital investment is specific. In this case, a scheme of state-dependent taxes and subsides, equalizing expected income across sectors, avoids the (inefficient) full specialization of the country and increases aggregate welfare.

The presence of uncertainty also provides an economic justification for the existence of a Welfare State. If the environment is stochastic, the Welfare State performs two important functions: 1) to insure domestic population; 2) to favour risk-taking behaviors by economic agents (Sinn, 1995)[2]. But, during the last two decades, several scholars have put under attack the sustainability and the optimality of the Welfare State in an increasingly globalized world (see i.e. Alesina and Perotti, 1997). The basic idea is that, in order to spur country's competitiveness, the Welfare State should be drastically reduced. Others have, on the contrary, emphasized that, since higher trade integration may increase the level of uncertainty each country faces, there is probably the need for more and not less Welfare State (Andersen (2002), Bowles and Pagano, 2006).

Much less attention has been devoted to the analysis of the effects of globalization on the working of the Welfare State and whether, in turn, these changes could reduce the benefits of higher trade integration, making free trade sub-optimal. Rodrik (1997) shows that, as trade integration increases, the tax base becomes more footloose because of the different international mobility cost of production factors. As a consequence, as globalization proceeds, the cost to sustain the Welfare State increases for the immobile factor (i.e. labour). This implies that workers' support to maintain the domestic market open is progressively eroded and that the return to protectionism becomes a real possibility.

The present paper identifies another channel through which a similar outcome can be produced. The basic intuition is that, under uncertainty, increasing specialization is not without costs. Indeed, as Pagano (2003) pointed out:

'*Net* gains of international specialization should take into account the

[1]In their model tariffs and export subsides are preferred to factor or product taxes.

[2]Sinn (1995) presents a closed economy model in which the Welfare State accomplishes both functions. For an illustration of the effects of the risk-inducer activity of the Welfare State in an open economy context see Arachi and D'Antoni (2004).

> costs of supplying internal social protection that increase when the productive diversification of the National Economy is decreased.' (Pagano, 2003 , p.15)

This idea is captured in the following two-sector specific factor model modified to consider: 1) uncertainty, in the form of stochastic production technologies (productivity shocks); 2) temporary specificity also of the mobile factor (labour). A stochastic parameter determines in each period which sectors is *lucky*, i.e. the comparative advantaged sector, and the *unlucky*, i.e. the comparatively disadvantaged one. While capital is sector specific, labour is mobile across sectors. But workers' mobility is not perfect: workers cannot relocate immediately after uncertainty resolves. This gives room to the positive role of insurance. Insurance is provided by (an extremely stylized) Welfare State. In particular, the benevolent government has the objective to equalize incomes across sectors and to this end uses a system of state-contingent transfers that redistributes from the *lucky* to the *unlucky*[3]. In the second period, when uncertainty has resolved, workers in the *lucky* sector are taxed to finance a (fixed) transfer B that goes to all the workers in the *unlucky* sector. The most important feature of this insurance mechanism is that preferences and workers' specialization decision determine the sectoral tax level necessary to finance the system. I consider two distinct ways of choosing τ. First I consider τ as exogenous, i.e. as resulting from a (non-modeled) bargaining process between the workers and the government. Then I explore the effects of τ when its level is chosen by a benevolent government that maximizes the welfare gains produced by the insurance mechanism. I demonstrate that, for a sufficiently high level of uncertainty, risk averse agents always prefer the Welfare State to the no-insurance situation, and that these results holds both under autarky and free trade. The main result of the model is that, if the induced reallocation of workers is too large, it is possible that aggregate (expected) income under free trade is lower than the autarky one.

The model identifies the existence of a *trade-off*, new to the literature, between gains form specialization (due to higher trade integration) and gains from insurance (due to the presence of the Welfare State), and thus provides an argument against any naive application of the comparative advantage doctrine. To the best of my knowledge, this is the first paper that, modeling the impact of free-trade-induced specialization on

[3]In principle this insurance function could be possible privately provided. However,

> 'It is difficult to imagine endowing private agencies with the extensive monitoring and enforcement rights enjoyed by tax authorities, and in the absence of such rights, moral hazard and adverse selection problems renders a broad based private solution impossible.' (Sinn, 1995).

the working of the Welfare State, shows that the gains from trade are not necessarily increasing in the level of trade integration.

The paper proceeds as follows. In the next section I present a two-sector specific factor trade model with uncertainty in which the government uses a tax-based insurance mechanism, i.e. the Welfare State, to stabilizes income of risk averse agents. In section 3.3, I characterize both the autarky and the free trade equilibrium, I measure the welfare effects of moving from autarky to free trade and of introducing the Welfare State under both scenarios. Finally I derive the conditions under which autarky is welfare superior with respect to free trade. Section 3.4 concludes.

3.2 The model

In this section I present a specific-factor model with technological uncertainty. As it is usually done in models of trade under uncertainty (see for instance Newbery and Stiglitz (1984)), I make the following two assumptions. First, the *market* fails to provide insurance of specific investment. Since I will consider the case of human capital investment, this assumption is less heroic than it may appear. The private insurer, unable to distinguish clearly between exogenous events and the endogenous behaviour of the worker, would provide an incentive for the insured worker to work less hard or to choose the riskiest job. In such a situation the well-know problems of moral hazard and adverse selection are particularly strong and the market is unlikely to provide insurance for wage variance[4]. Second, workers cannot fully diversify risk through international capital markets. In fact, while it is true that there is an increasing trend in this direction, this possibility still pertain primarily to institutional investors, i.e. pension funds[5].

3.2.1 Production and uncertainty

Consider a small country populated by N risk averse maximizing workers. There are three goods. Goods x and y are manufactured for export, while good z is imported for consumption. The latter is the numeraire good[6]. Both export sectors are subject to uncertainty in the form of a stochastic technology parameter. The two sectors are

[4]Andersen (2002) argues that international integration is not reducing capital markets problems related to human capital insurance.

[5]According to van Wincoop (1991) the assumption that there is no international trade in risky assets is a more realistic assumption than the opposite.

[6]This assumption limits the effect of uncertainty on consumption to indirect effect through income. (Brainard, 1991).

characterised by the following production technologies:

$$X = \theta_x K^{\alpha} L_x^{1-\alpha}$$

and

$$Y = \theta_y T^{\alpha} L_y^{1-\alpha}$$

where $i = x, y$, L_i is the labour input in sector i (with $L_x + L_y = \bar{L}$), θ_i is a stochastic technology parameter, K and T are the specific capital to sector x and y, respectively and are assumed to be owned by foreign individuals.

To simplify the analysis, assume that there are only two states of the world, which appears with given, constant probabilities. The θ_i parameter is thus distributed according to the following binomial distributions:

$$\theta_x = \begin{cases} 0 & \text{if } j = 1 \\ 1 & \text{if } j = 2 \end{cases} \qquad \theta_y = \begin{cases} 1 & \text{if } j = 1 \\ 0 & \text{if } j = 2 \end{cases}$$

where j is the state of the world, with

$$P[j = 1] = \pi_1 \qquad \text{and} \qquad P[j = 2] = \pi_2 = (1 - \pi_1)$$

Sector $i = \{x, y\}$ is said to be *lucky* if $\theta_i = 1$, i.e. if the sectoral output level is positive. This is a very simple way to formalize two situations: 1) cases of (extreme) technological uncertainty, e.g. the case of agricultural production; 2) instances in which comparative advantages have a stochastic component that dominates the institutional and economic determinants of sectoral relative productivities.

3.2.2 Labour income and the Welfare State

Labour Income Workers are assumed to be internationally immobile, i.e. because of cultural and/or linguistic barriers. Each is endowed with one unit of labour that she inelastically supplies in a competitive labor market. Aggregate labour supply (and total number of workers) in sector i is:

$$L_i = \sum_{h \in i} s_{ih} \qquad i = x, y \qquad h = 1, 2, ..n$$

where s_h is the individual labour supply.

Also the good markets are perfectly competitive. The *pre-tax* wage is the value of

the marginal product of labour in the two sectors and it is given by

$$w_x = p_x \theta_x (1-\alpha) \left(\frac{K}{L_x}\right)^{\alpha} \tag{1}$$

$$w_y = p_y \theta_y (1-\alpha) \left(\frac{T}{L_y}\right)^{\alpha} \tag{2}$$

At the beginning of the period, before the state of the world is known, each worker decides in which domestic sector to invest her unit of human capital, i.e. where to be employed. The equilibrium is reached when expected sectoral wages are equalized across sectors. Once the investment decision has been made, workers are assumed to become specific to the sector. Then uncertainty resolves and the lucky (and the unlucky) sector is determined. The specificity assumption implies that, after uncertainty resolves and payoff are revealed, it is not possible to immediately move from one sector to the other. As I will show below, it is the existence of this 'friction' in the labour market that makes the provision of an insurance scheme welfare increasing.

The Welfare State: taxation as an insurance device The working of the Welfare State (i.e. tax-based insurance mechanism) is extremely simple: in the second period, when uncertainty resolves, workers in the *lucky* sector are taxed and the workers in the *unlucky* sector receive a transfer B.[7] The state-contingent redistributive scheme is as follows:

$$B_x = \begin{cases} \tau & \text{if } j = 1 \\ 0 & \text{if } j = 2 \end{cases} \tag{3}$$

$$B_y = \begin{cases} 0 & \text{if } j = 1 \\ \tau & \text{if } j = 2 \end{cases}$$

where τ is the fixed transfer the worker receives when the sector she is employed into is *unlucky*.

I will consider two distinct way of choosing τ. First, τ is the result of a (non-modeled) bargaining process between the workers and the government. In this case, the level of the transfer is exogenously fixed and τ is a parameter. Second the level of τ is chosen by a benevolent government that maximizes the welfare increasing effect of the insurance mechanism. The case of endogenous τ is discussed in section 3.3.3. For the moment, I begin considering τ as a parameter.

Since the other case if perfectly identical, I proceed describing the model in case

[7]For instance, it is possible to interpret B as a temporary unemployment benefit.

in which y results to be 'unlucky' (i.e. $j = 2$). In this case the government budget constraint reads:

$$\tau L_y = t_x L_x w_x \tag{4}$$

where τ is the individual transfer, t_x is the wage tax imposed on workers in sector x (i.e. the 'lucky' sector), L_y and L_x are the number of workers employed in sector y and x, respectively. Thus we have:

$$t_x = \frac{\tau L_y}{w_x L_x} \tag{5}$$

The important thing to note is that the sectoral tax rate necessary to finance the system depends on preferences and workers' specialization decisions. Given this redistributive mechanism, it is immediate to see that taxation has two effects:

- it reduces individual income (*income effect*)
- it reduces variability of income and thus increases individual utility (*government risk sharing effect*)

In the following I characterize both the autarky and the free trade equilibrium with and without the Welfare state.

3.3 Results

3.3.1 Autarky

In this section I characterize the autarky equilibrium. I also derive the conditions under which the Welfare State, i.e. the insurance mechanism introduced in the previous section, is welfare improving.

In the following, the superscript a identifies the variables in the autarky situation. Since the focus of the model is not consumption decision, I make the simplifying assumption that workers spend an equal share of income for each good. Finally assume that $K = T$.

As a consequence of the symmetry assumptions made, in the autarky equilibrium workers are equally distributed among the two sectors. In addition, since the labour-output ratio in both sectors is equal, the relative price is $p = p_y/p_x = 1$. It also holds that:

$$E(w_x) = E(w_y)$$

where $E(\cdot)$ is the expectation operator.

Labour income for workers in sector y is:

$$I_{yj} = \begin{cases} \omega_y & \text{if } j = 1 \\ B_y & \text{if } j = 2 \end{cases}$$

where $\omega_y = (1 - t_y)w_y$ is the net of taxes sectoral wage. Using (2) and (3):

$$I_{yj} = \begin{cases} (1 - t_y)p_y(1 - \alpha)K^{\alpha}L_y^{-\alpha} & \text{if } j = 1 \\ \tau & \text{if } j = 2 \end{cases}$$

Normalizing $\bar{L} = 1$, income in sector x is given by

$$I_{xj} = \begin{cases} \tau & \text{if } j = 1 \\ (1 - t_x)p_x(1 - \alpha)T^{\alpha}(1 - L_y)^{-\alpha} & \text{if } j = 2 \end{cases}$$

Expected aggregate welfare is the weighted sum of workers' utilities. Formally[8]

$$W^z = L_y^z E(U_y^z) + (1 - L_y^z)E(U_x^z) \tag{6}$$

where

$$E(U_i^z) = \pi_1 U_{i1}^z + (1 - \pi_1)U_{i2}^z \tag{7}$$

is expected utility of workers in sector i, and

$$U_{ij}^z = 1 - e^{-rI_{ij}^z} \tag{8}$$

is workers' utility in sector i when the state of the world is j and $z = \{a, ft\}$ is the superscript to indicate that the variable refers to the autarky or free trade situation, respectively. The parameter $r \geq 0$ measures the degree of risk aversion. As it is immediate to show, this utility features constant absolute risk aversion (r) and increasing relative risk aversion (rI).

The effect of taxation under autarky As a first step, I consider the effect of the introduction of the tax-based insurance mechanism, i.e. Welfare State, in the economy under autarky. In order to evaluate the benefits of the Welfare State, I compare the aggregate welfare (computed as the sum of individual expected utilities) in the two situations. Define the difference between aggregate welfare with and without the

[8]Note that (6) is equivalent to

$$W = \pi_1[U_{y1}L_y + U_{x1}(1 - L_y)] + (1 - \pi_1)[U_{y2}L_y + U_{x2}(1 - L_y)]$$

welfare state as:

$$\Delta = W^a_{tax} - W^a \tag{9}$$

where

$$W^a_{tax} = L^a_y E(U^a_{y,tax}) + (1 - L^a_y)E(U^a_{x,tax})$$

is the autarky expected welfare when there is the tax-based insurance mechanism and

$$W^a = L^a_y E(U^a_y) + (1 - L^a_y)E(U^a_x)$$

is the aggregate expected welfare under autarky when there is no Welfare State.

Proposition 1 *If $\pi_1 < \bar{\pi}$ the taxation mechanism is welfare improving and its positive effect increases with the degree of workers' risk aversion.*

Proof. See Appendix ■

Proposition 1 states that if the probability of good state is not much bigger than the probability of bad state, i.e. there is a high uncertainty, then the taxation mechanism is worth pursuing. In addition it demonstrate that, for a given level of uncertainty, the higher the risk aversion the more useful is the Welfare State. The result that the insurance mechanism is welfare improving when the environment is highly uncertain is clearly shown by Figure 3.1[9] where the difference (for any given level of risk aversion) between the autarky welfare level with taxation and without it, is plotted for $\pi_1 = \pi_2$.

3.3.2 Free Trade

What happens when our small country enters free trade? According to standard trade theory, the domestic relative price will converge to the world one. Assume, for instance, that $p = p_y/p_x$ (the domestic relative price under autarky) is lower than under free trade, i.e. $p^{ft} > p = 1$. This implies that, given the autarky allocation of workers, at the free trade price we have that:

$$E(w_y) > E(w_x)$$

Free trade brings in a modification of the relative profitability of the two sectors and the expected wage in sector y is now higher than the one in sector x. As a consequence,

[9] All the figure are drawn using the following parameters' values: $T = K = 1$, $\pi_1 = \pi_2 = 0.5$, $\alpha = 0.5$. The transfer is fixed at $\tau = 0.35$. This seems to be a 'fair' value to evaluate the effects of the Welfare State because it is half the wage rate under autarky. As it will shown in section 3.3.3, this is also the value that, for this configuration of parameters, maximizes the welfare effect of taxation.

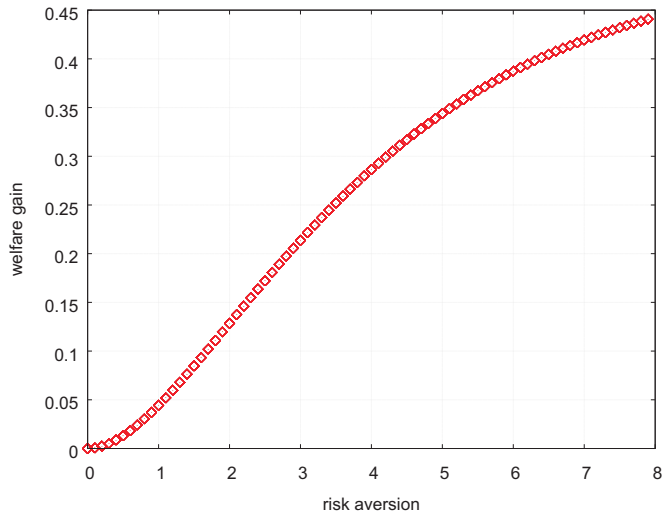

Figure 3.1: Welfare gain of insurance under autarky

workers reallocation toward sector y, i.e. the sector in which the country has the comparative advantage, takes place and the free trade equilibrium is reached when expected wages (equations (1) and (2)) are equalized for the new value of p_y.

The number of workers in sector y under free trade is given by:

$$L_y^{ft} = \left[1 + \left(\frac{\theta_x}{p_y \theta_y}\right)^{\frac{1}{\alpha}} \frac{K}{T}\right]^{-1} \tag{10}$$

Since in a two-sector model the level of specialization is given by the ratio of the number of workers employed in each sector and our autarky equilibrium is perfectly symmetric, equation (10) shows that the level of specialization increases with the free trade price.

In the following, I will compare the free trade equilibrium (with and without Welfare State) with the autarky one.

Free trade vs autarky Is the free trade equilibrium welfare superior to autarky[10]? As in the standard specific-factor model the answer is yes. This is stated in the following:

Proposition 2 *Free trade is always superior to autarky. The welfare gain of free trade increases with the specialization level and decreases with the risk aversion.*

Proof. See Appendix ■

[10]Note that here we are considering a comparison between the sum of workers' expected utilities under free trade and under autarky. No discussion will be made concerning Pareto superiority of free trade over autarky in this model.

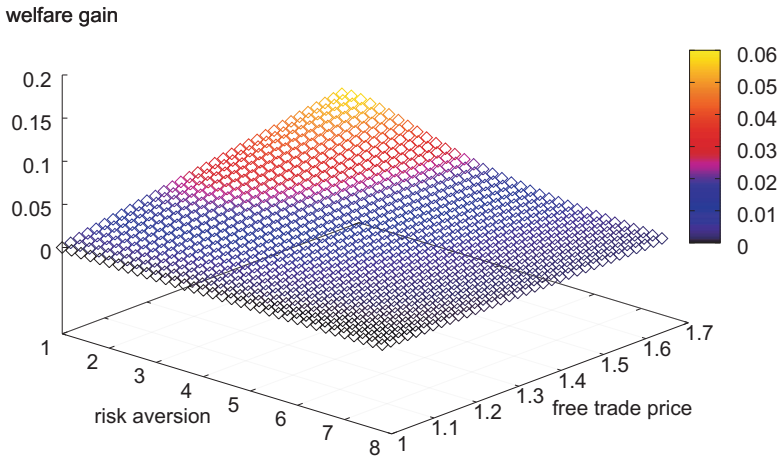

Figure 3.2: Free trade vs autarky

While the fact that higher specialization increases the welfare gain is not surprising, the presence of uncertainty has an interesting and unexpected effect. Under uncertainty, for high levels of risk aversion, the benefits of specialization may become relatively small, and thus the welfare gain negligible. This is shown in Figure 3.2 the welfare gains arisings from free trade are increasing in the free trade price (and in the level of specialization) but the negative effect of risk aversion eats out all the welfare benefits for high levels of r.

The effect of taxation Proposition 1 (section 3.3.1) states the conditions under which the tax-base insurance mechanism is welfare improving under autarky. A similar result can be derived for the free trade situation.

Proposition 3 *Under free trade, the welfare gain due to the existence of the Welfare State increases with the degree of risk aversion and decreases with the free trade price.*

Proof. See Appendix ■

Figure 3.3 illustrates this result. Figure 3.3 plots:

$$\Omega = W^{ft}_{tax} - W^{ft} \tag{11}$$

i.e. the difference, for each combination of free trade price and level of risk aversion, between aggregate welfare with and without the Welfare State. The positive effect of the existence of a Welfare State is higher the higher the risk aversion and the lower the free trade price (i.e. the lower the specialization gains). For a given free trade price, as risk aversion increases, the welfare gain increases because insurance is more valuable to

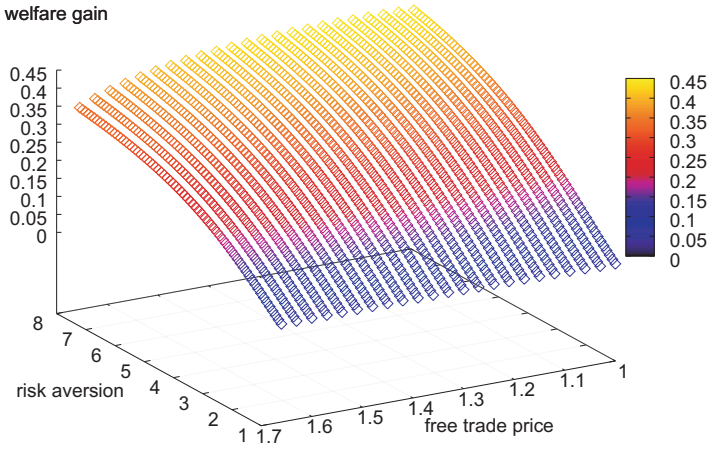

Figure 3.3: Welfare gain of insurance under free trade

the workers. Conversely, for a given degree of risk aversion r, the higher the free trade price, the lower the welfare gain of insurance. In fact, the higher level of specialization the higher the wages and aggregate welfare: under this circumstance the relative effect of the Welfare State becomes smaller. These results suggests that, when workers are risk averse, specialization and insurance are substitutes.

Gains from specialization and risk aversion Is it possible to identify to 'measure' the gains from specialization and the benefit of insurance and to compare them? The net effects of the two on aggregate welfare can be easily calculated looking at the behavior of

$$\Theta = W^{ft} - W^{a}_{tax} \tag{12}$$

where Θ measures the difference between specialization gains and insurance gains. To understand why, note that W^{a}_{tax} is equivalent to the welfare level under free trade with Welfare State and $p_{ft} = 1$. Thus the first term captures only the specialization gains while the second only the effect of insurance. Their relationship is summarized by the following:

Proposition 4 *The welfare gain of free trade is increasing with the free trade price but decreasing with risk aversion.*

Proof. See Appendix ■

Proposition 4 has two interesting consequences. First, it shows that it (always) exists a combination of risk aversion and free trade price $[\hat{p}_{ft}, \hat{r}]$ for which if $p > \hat{p}_{ft}$ or $r < \hat{r}$ gains from specialization are higher than the insurance effect of the Welfare State. In addition, it implies that gains from trade increase with specialization only if risk aversion is not too high.

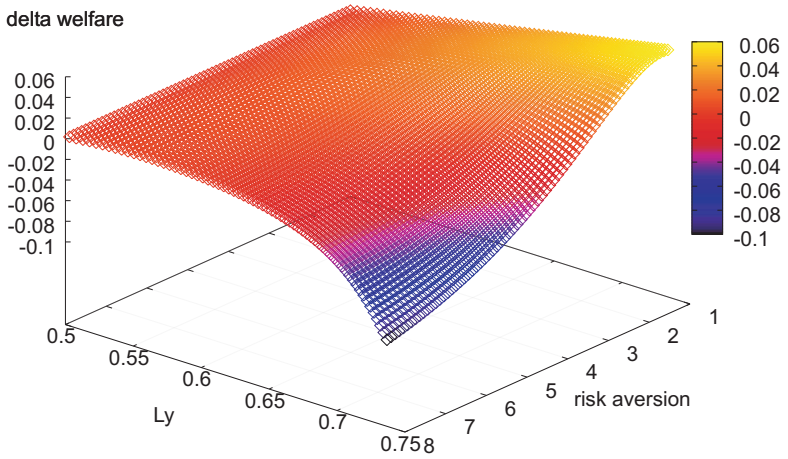

Figure 3.4: Free trade vs. autarky with Welfare State

3.3.3 The main result: welfare state and gains from specialization

We are now ready to describe the main result of the model. Since, as shown in Proposition 1 and Proposition 3, the Welfare State is welfare improving under both autarky and free trade, the fact that the free trade induced-specialization level determines not only the gains from trade but *also* the cost of supplying internal insurance is a matter of concern. The existence of a trade-off between specialization and insurance gains implies that, if the economy specializes *too much*, the rise in the cost of maintaining the Welfare State may outweighs the gains from trade benefits, making free trade welfare inferior with respect to autarky. This result is shown in Figure 3.4 which plots:

$$\Gamma = W_{tax}^{ft} - W_{tax}^{a} \tag{13}$$

where

$$W_{tax}^{ft} = L_y^{ft} E(U_{y,tax}^{ft}) + (1 - L_y^{ft}) E(U_{x,tax}^{ft})$$

is the aggregate expected welfare under free trade cum insurance mechanisms and

$$W_{tax}^{a} = L_y^{a} E(U_{y,tax}^{a}) + (1 - L_y^{a}) E(U_{y,tax}^{a})$$

is the autarky welfare with Welfare State.

The numerical example[11] shows that there exists a set of parameters' configuration

[11]The model has been numerically solved using FORTRAN77. The code programs are available upon request. In the numerical example the following parameters are used: $T = K = 1$, $\pi_1 = \pi_2 = 0.5$, $\alpha = 0.5$. The transfer is fixed at $\tau = 0.35$. This seems to be a reasonable values because it is half of the wage rate under autarky. As it will shown in section 3.3.3, this is also the value that, for this configuration of parameters, maximizes the welfare effect of taxation. Effects of changes in the parameters' values are explored in section 3.3.3.

(risk aversion and level of specialization) for which the welfare level of free trade with Welfare State is lower than the corresponding autarky one. For low levels of risk aversion, opening to free trade is welfare improving and the gains increase with the free trade price and thus with the degree of specialization (i.e. L_y). But for high levels of risk aversion. the trade-induced increase in the specialization level can reduce the expected aggregate welfare. Changes in the relative prices, induce workers reallocation toward the now more profitable sector y until marginal productivity of factors is equalized. The resulting (now higher) specialization level yields higher wages for all workers but, at the same time, it increases the variability of income for the ones in the x sector.

To understand why note that free trade has two effect on the tax rate. Consider the case in which y is unlucky. Recalling that (5) reads

$$t_x = \frac{B_x L_y}{w_x(1 - L_y)}$$

it is clear that the tax rate for workers employed in sector x is subject to two opposite forces. First, free trade tends to reduce the tax rate because of the increase of the wage rate (w_x increases). At the same time the reallocation of workers toward y tend to increase it (L_y increases). It is thus possible that for high levels of p_{ft} the second effect prevails (i.e. the reallocation of workers toward sector y is higher than the positive effect of higher sectoral wage) and the net effect makes the expected wage in sector x lower than under autarky[12].

Under free trade with Welfare State, individual expected sectoral incomes are:

$$E\left[U(I_y)\right] = \pi_1 U\left(\omega_y^{ft}\right) + \pi_2 U\left(\tau\right) \tag{14}$$

$$E\left[U(I_x)\right] = \pi_1 U\left(\tau\right) + \pi_2 U\left(\omega_x^{ft}\right) \tag{15}$$

where $\omega_y^{ft} > \omega_x^{ft}$ because $t_x^{ft} > t_y^{ft}$. Following trade integration more workers becomes employed in sector y (see equation 10). This implies that, if the state of the world is $j = 1$ (sector y is *unlucky*), workers in sector x will be heavily taxed in order to comply with the (fixed) transfer B for workers in sector y. Conversely, if the state of the world is $j = 2$, the comparative advantaged sector is lucky and, being the wage higher and the workers in sector x less than under autarky, the expected utility is higher. Indeed, when the sector is unlucky the income workers receive is the same. But, when the state of the world is lucky, while the net wage in sector y is higher than under autarky (the wage is higher and the tax is lower), in sector x the net expected wage can be lower for high level of p_{ft}. This is shown in Figure 3.5 and Figure 3.6 where sectoral expected

[12]Note that for the same reasoning t_y is always lower under free trade than under autarky.

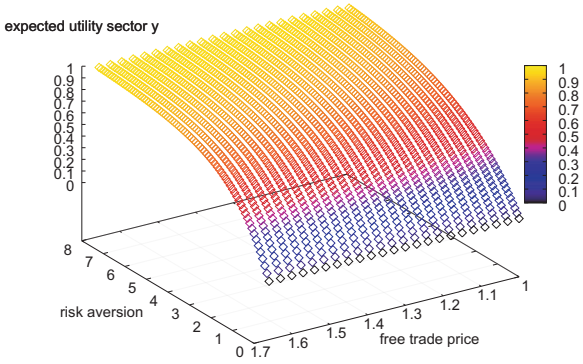

Figure 3.5: Expected utility workers sector y

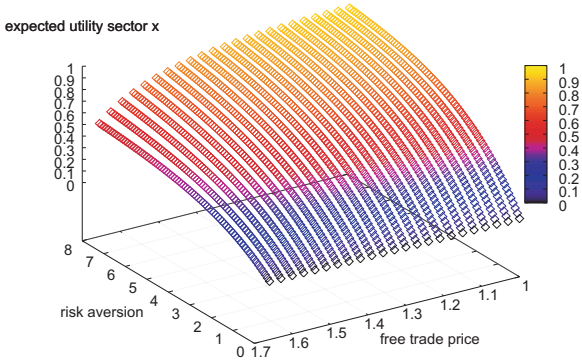

Figure 3.6: Expected utility workers sector x

utility are depicted. Expected utility is increasing in the free trade price (i.e. in the specialization level) for workers in sector y but, for high level of risk aversion, it is (non linearly) decreasing for workers in sector x.

Sensitivity of the results to the parameters' values The result presented in the previous section crucially depends upon two parameters: 1) the probability of good and bad state (π); 2) the level of the transfer (τ).

It is clear that an increase in the probability that the comparative advantaged sector is 'lucky' (i.e. higher values of π_1) makes free trade more attractive[13]. For each level of risk aversion, there is a level of π_1 for which free trade is always superior to autarky with free trade, even if this level increases with r. This is so because the aggregate advantages of specialization (for a large share of population) are stronger than the reduction of (expected) income for workers in the disadvantaged sector.

When the level of the transfer is exogenously given, *ceteris paribus*, a lower τ has four effects. First, the welfare gain from insurance is smaller. Second, the lower the τ the larger the range of free trade prices for which specialization gains are higher than insurance gains (see (12)). Indeed, if the transfer level is lower the individual tax burden for workers in sector x is smaller for any trade-induced specialization level and its insurance effect smaller. Third, there is a larger set of parameters for which free trade with insurance is always welfare superior to autarky with insurance (equation 13). Finally, a lower τ makes larger the range of values of p_{ft} for which the welfare system is sustainable - i.e. $t_i < 1$ with $i = x, y$.[14]

Since the level of the transfer plays a crucial role in determining the main result of

[13]This implies that if the comparative advantaged sector is subject to high sectoral risk the expected welfare gain of free trade is lower.

[14]Indeed all the reported Figures show the range of free trade prices for which the system is sustainable. For higher levels of τ, the system becomes not sustainable for lower levels of specialization.

the model, in order to check its robustness, the following section considers a different way of choosing τ.

Optimal transfer

While until now τ entered the model as a parameter, in the following I will compare the autarky and the free trade equilibria when the level of τ is optimally chosen by a benevolent welfare maximizer government.

Definition 1 *The optimal transfer τ^* is the value of τ that, for given level of risk aversion, maximizes the welfare gains of Welfare State for a given level of specialization.*

I begin reporting some results concerning the value of the optimal transfer under autarky and free trade. Given our symmetric setting under autarky, it follows that the optimal level of the transfer is independent from the degree of risk aversion and on the probability of good and bad state. Instead, it depends on α: when the distributive parameter increases (i.e. the share of aggregate income that goes to labour decreases), the optimal level of τ decreases and the welfare gain of taxation decreases as well. The optimal level of τ is $\tau^* = 0.35$ and it is unique. Under autarky the welfare increasing condition of the insurance mechanism is: $\omega > \tau$. When $\omega < \tau$, for increasing τ welfare decreases. Numerical results[15] shows that under free trade, for given risk aversion, higher specialization (i.e. a higher free trade price) is coupled with a lower level of the optimal transfer. At the same time, the welfare gain of using the optimal τ increases with the degree of risk aversion but decreases with the level of specialization.

Proposition 3 states that, for a given level of the transfer, the welfare effect of the Welfare State changes with the degree of risk aversion and with the free trade price. Since also the optimal value of τ changes with p_{ft} and r, I now compare autarky and free trade with Welfare State when the transfer is set to the optimal level τ^* (i.e. the level that maximizes the welfare gain of insurance). Figure 3.7, 3.8 and 3.9 plot, for a given level of risk aversion, the difference between autarky and free trade welfare with optimal τ[16]. The results show that for low levels of risk aversion, free trade is always

[15]The optimal transfer under free trade is calculated in the following way. Given the level of risk aversion, the program calculates the welfare level in absence of Welfare State for any level of the free trade price. Then, for each free trade price and any sustainable level of τ (i.e. the level of the transfer for which $t_x < 1$ and $t_y < 1$), it computes the welfare level when there is the Welfare State. The optimal τ for a given level of free trade price (and risk aversion) is the value of τ that maximize the difference between the two computed welfare levels.

[16]The reported results are obtained in the following way. The program calculates the welfare level under autarky when there is the Welfare State and the transfer is set to the optimal level, i.e. the one that maximizes the difference between welfare with and without Welfare State. Then, for a given the level of risk aversion, it determines the optimal value of τ^* for each value of p_{ft}. As a final step, it computes the difference between the 'optimal' welfare under autarky and free trade.

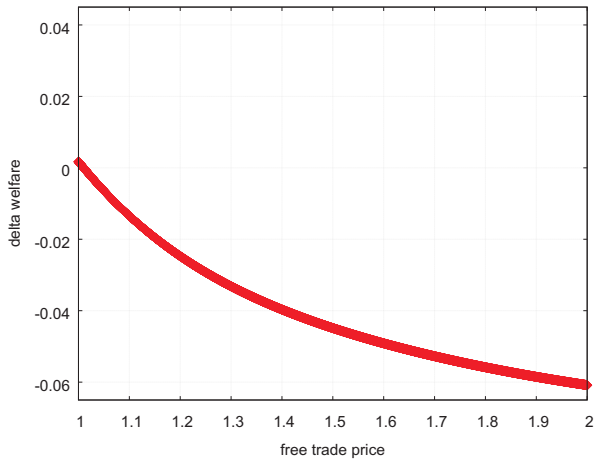

Figure 3.7: Welfare difference ($W^a_{tax} - W^{ft}_{tax}$) with optimal τ^* - Low risk version; $r = 2$

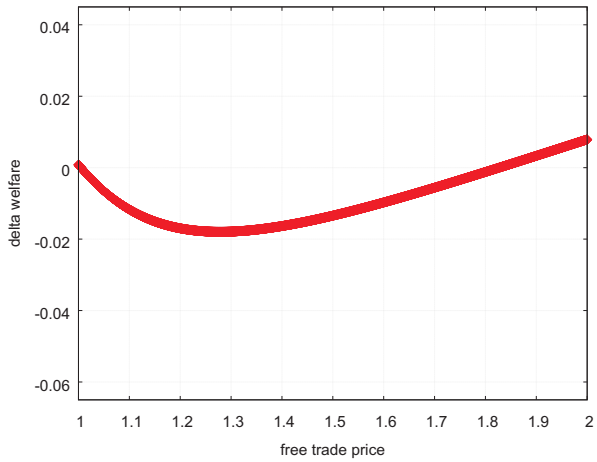

Figure 3.8: Welfare difference ($W^a_{tax} - W^{ft}_{tax}$) with optimal τ^* - Medium risk version; $r = 4$

welfare superior to autarky. But as risk aversion increases, the set of specialization levels for which autarky is welfare superior to free trade becomes non empty. Indeed the range of specialization levels (i.e. free trade prices) for which this is true it rapidly enlarges with risk aversion. These results are important because they demonstrate that the theoretical possibility of welfare inferiority of free trade is robust to the way τ is chosen. In fact, even in the case in which the transfer is assumed to be set at the optimal level by a maximizing benevolent central planner, the expected welfare under free trade can be lower than the corresponding autarky one if the country specializes *too much*.

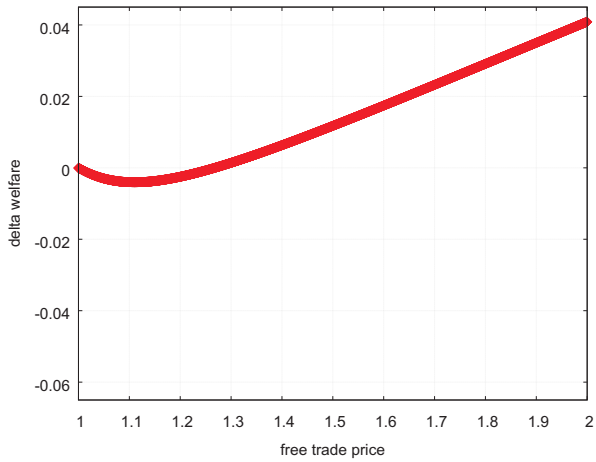

Figure 3.9: Welfare difference ($W^a_{tax} - W^{ft}_{tax}$) with optimal τ^* - High risk version; $r = 8$

3.4 Concluding remarks

This paper presented a simple model showing that, under uncertainty, increasing trade integration entails both benefits and costs. The changes in the specialization level induced by opening up the economy not only determines the gains from trade but *also* the cost of supplying a Welfare State and how this burden is distributed across agents. As a first step, I have derived the conditions under which the provision of the tax-based insurance scheme, i.e. the Welfare State, is welfare increasing under autarky and free trade. Then I have shown that the superiority of free trade *vs* autarky crucially depends on the effects that opening up the economy has on the working of the Welfare State. The main result of the model is that, under proper limitation of the parameters' space, if the economy specializes *too much* the cost of insuring workers may become bigger than the gains from opening up the economy. In this case, free trade turns out to be welfare inferior with respect to autarky[17].

One possible solution to the negative effect of increasing trade integration here described would be the creation of a reliable system of international insurance (Pagano, 2003). But in the likely absence of it, free trade can, *via* the mechanism here described, bring a reduction of welfare in each and all countries. Thus this model shows that a 'naive' application of the comparative advantage doctrine may be misleading and that, since gains from specialization and the cost of insurance are the two sides of the same

[17]The argument presented in this paper could be also reformulated considering a movement from a free trade position toward a situation in which there is a positive level of protection. Noting that a lower level of specialization reduces the cost of the insurance redistributive scheme, it follows that, if agents' level of risk aversion is high, increasing protection has a first order effect on aggregate welfare while the productivity loss (due to de-specialization and allocative inefficiency) is of second order. In this sense the optimal rule for increasing (reducing) protection would state that efficiency gains should never be higher (lower) than insurance gain (loss).

coin, only a good balance between the two would insure the maximization of welfare.

A convenient feature of the present model is that its basic framework could be easily extended. Two directions seems particularly promising. The model could be easily generalized to consider also other sources of gains from trade, i.e. technological spillovers or increasing returns. Since the basic idea of the model is that increasing specialization increases the gains from trade but it also has an impact on the cost of supplying a Welfare State, the argument remains valid if other sources of gains from trade are added. A second direction of future research concerns the modelization of the Welfare State. In this version of the model, I limited myself to consider only the insurance-provider function of the Welfare State. Further research should be devoted to incorporate a more sophisticated formalization of the taxation scheme and of the working of the Welfare State in order to consider also its risk-taking inducer function.

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Appendix

Proof of Proposition 1 Consider equation (9)

$$\Delta = W^a_{tax} - W^a$$

The Welfare State is welfare increasing if

$$\begin{aligned} W^a_{tax} &> W^a \\ L^a_y E(U^a_{y,tax}) + L^a_x E(U^a_{x,tax}) &> L^a_y E(U^a_y) + L^a_x E(U^a_x) \end{aligned} \tag{16}$$

Since $L^a_y = L^a_x$ and utility are equalized under each system (i.e. taxation and no-taxation), condition 16 is satisfied if

$$\begin{aligned} E(U^a_{y,tax}) &> E(U^a_y) \\ \pi_1 \left[1 - e^{-r(1-\alpha)(1-t)p_y K^\alpha L_y^{-\alpha}}\right] + (1-\pi_1)\left(1 - e^{-r\tau}\right) &> \pi_1 \left[1 - e^{-r(1-\alpha)p_y K^\alpha L_y^{-\alpha}}\right] \end{aligned}$$

since $t = \frac{\tau}{w_y}$ we have

$$\begin{aligned} \pi_1 - \pi_1 e^{-r(1-\alpha)(1-t)p_y K^\alpha L_y^{-\alpha} + r\tau} + 1 - e^{-r\tau} - \pi_1 + \pi_1 e^{-r\tau} - \pi_1 + \pi_1 e^{-r(1-\alpha)p_y K^\alpha L_y^{-\alpha}} &> 0 \\ 1 - e^{-r\tau} + \pi_1 e^{-r\tau} - \pi_1 + \pi_1 e^{-r(1-\alpha)K^\alpha L_y^{-\alpha}}(1 - e^{-r\tau}) &> 0 \\ 1 - e^{-r\tau} + \pi_1 \left[e^{-r\tau} - 1 + e^{-r(1-\alpha)K^\alpha L_y^{-\alpha}}(1 - e^{-r\tau})\right] &> 0 \end{aligned}$$

And finally,

$$\pi_1 < \frac{1 - e^{-r\tau}}{1 - e^{-r\tau} - \left(1 - e^{r\tau}\right) e^{-r(1-\alpha)K^\alpha L^{-\alpha}}} \tag{17}$$

where the denominator is always positive. Thus, if $\pi_1 < \bar{\pi}$, the tax-based insurance mechanism is welfare increasing.

Then I demonstrate that that the higher the degree of risk aversion r, the higher the welfare gain of the welfare State. This is shown differentiating (17) with respect to r. To simplify the notation define $\gamma = (1-\alpha)p_y K^\alpha L_y^{-\alpha}$. I obtain:

$$\begin{aligned} \frac{\partial \bar{\pi}}{\partial r} &= \frac{\tau e^{-r\tau}}{1 - e^{-r\tau} + \frac{e^{r\tau}-1}{e^{r\gamma}}} - \frac{\left(1 - e^{-r\tau}\right)\left(\tau e^{-r\tau} + \frac{\tau e^{r\tau}}{e^{r\gamma}} - \frac{e^{r\tau}-1)\gamma}{e^{r\gamma}}\right)}{\left[1 - e^{-r\tau} + \frac{(e^{r\tau}-1)}{e^{r\gamma}}\right]^2} \\ &= \frac{2\tau e^{r\gamma} - \tau e^{r(-\tau+\gamma)} - e^{r(\gamma+\tau)}\tau + e^{r(\gamma+\tau)}\gamma - 2e^{r\gamma}\gamma + e^{r(-\tau+\gamma)}\gamma)}{\left[-e^{r\gamma} + e^{r(-\tau+\gamma)} - e^{r\tau} + 1\right]^2} \end{aligned}$$

Since the denominator is always positive we consider just the numerator and we have:

$$\begin{aligned} 2e^{r\gamma}(\tau-\gamma)+e^{r(-\tau+\gamma)}(\gamma-\tau)+e^{r(\gamma+\tau)}(\gamma-\tau) &> 0 \\ (\gamma-\tau)\left[e^{r(\gamma-\tau)}+e^{r(\gamma+\tau)}-2e^{r\gamma}\right] &> 0 \\ (\gamma-\tau)\left[e^{r\gamma}e^{-\tau}+e^{r\gamma}e^{\tau}-2e^{r\gamma}\right] &> 0 \\ (\gamma-\tau)\left[e^{r\gamma}(e^{-\tau}+e^{\tau}-2)\right] &> 0 \end{aligned}$$

which is alway positive since

$$(e^{-\tau}+e^{\tau}-2)=\frac{e^{2\tau}-2e^{\tau}+1}{e^{\tau}}=\frac{(e^{\tau}-1)^2}{e^{\tau}}>0$$

Thus if the degree of risk aversion increases the support of the probability of good states for which taxation is welfare improving gets larger.

Proof of Proposition 2 Define the difference between aggregate welfare under free trade and autarky:

$$\begin{aligned} \Lambda &= W^{ft}-W^{a} \\ &= L_y^{ft}E\left(U_y^{ft}\right)+L_x^{ft}E\left(U_x^{ft}\right)-L_y^{a}E\left(U_y^{a}\right)-L_x^{ft}E\left(U_x^{ft}\right) \end{aligned}$$

Since, under each system, utility is equalized across sectors, it reduces to

$$\begin{aligned} \Lambda &= E\left(U_y^{ft}\right)\left[L_y^{ft}+L_x^{ft}\right]-E\left(U_y^{a}\right)\left[L_y^{a}+L_x^{a}\right] \\ &= E\left(U_y^{ft}\right)-E\left(U_y^{a}\right) \end{aligned}$$

Free trade is welfare superior to autarky if

$$\begin{aligned} E\left(U_y^{ft}\right) &> E\left(U_y^{a}\right) \\ \pi_1 U_{y1}^{ft}+(1-\pi_1)U_{y2}^{ft} &> \pi_1 U_{y1}^{a}+(1-\pi_1)U_{y2}^{a} \\ U_{y1}^{ft} &> U_{y1}^{a} \\ 1-e^{-rw_{ft}} &> 1-e^{-rw^{a}} \\ \frac{1}{e^{rw_a}} &> \frac{1}{e^{rw_{ft}}} \end{aligned} \tag{18}$$

because $U_{y2}^{ft}=U_{y2}^{a}=0$. Since $w_{ft}>w_a$, condition free trade is always welfare superior with respect to autarky. In addition, note that

- for given r, the higher w_{ft}, thus the higher the free trade price and the equilibrium specilization level, the higher the difference, thus the more welfare increasing is

free trade

- for given wages, the higher the risk aversion the lower the gains from specialization.

Proof of Proposition 3 The welfare effect of introducing a Welfare State under free trade is given by

$$\begin{aligned}\Omega &= W_{tax}^{ft} - W^{ft} \\ &= L_y^{ft} E\left(U_{y,tax}^{ft}\right) + L_x^{ft} E\left(U_{x,tax}^{ft}\right) - L_y^{ft} E\left(U_y^{ft}\right) - L_x^{ft} E\left(U_x^{ft}\right) \qquad (19)\end{aligned}$$

To simplify notation I suppress the index $_{ft}$. Expanding the summation it yields:

$$\begin{aligned}\Omega &= L_y E\left(U_{y,tax}\right) + L_x E\left(U_{x,tax}\right) - L_y E\left(U_y\right) - L_x E\left(U_x\right) \\ &= L_y\left\{\pi_1\left[1-e^{-r(1-t_y)w_{ft}}\right] + (1-\pi_1)(1-e^{-r\tau})\right\} + L_x\left\{\pi_1(1-e^{-r\tau}) + (1-\pi_1)\left[1-e^{-r(1-t_x)w_{ft}}\right.\right. \\ &+ L_y\pi_1(1-e^{-rw_{ft}}) + L_x(1-\pi_1)(1-e^{-rw_{ft}}) \\ &= L_y\left\{\pi_1 - \pi_1 e^{-r(1-t_y)w} - \pi_1 + \pi_1 e^{-r\tau}) + (1-\pi_1) - (1-\pi_1)e^{-r\tau}\right\} \\ &+ L_x\left\{\pi_1(1-e^{-r\tau}) + (1-\pi_1) - (1-\pi_1) + (1-\pi_1)\left[1-e^{-r(1-t_x)w} - 1 + e^{-rw}\right]\right\} \\ &= L_y\left\{\pi_1\left[e^{-rw} - e^{-r(1-t_y)w}\right] + (1-\pi_1)(1-e^{-r\tau})\right\} \\ &+ L_x\left\{\pi_1(1-e^{-r\tau}) + (1-\pi_1)\left[e^{-rw} - e^{-r(1-t_x)w}\right]\right\}\end{aligned}$$

Lets begin considering the effect of an increase of risk aversion. Call A the first term on the right-hand side of (20):

$$A = L_y\left\{\pi_1 e^{-rw}(1-e^{rt_y w}) + (1-\pi_1)(1-e^{-r\tau})\right\}$$

and B the second one:

$$B = L_x\left\{\pi_1(1-e^{-r\tau}) + (1-\pi_1)e^{-rw}(1-e^{-rt_x w})\right\}$$

Differentiating A with respect to r, it yields

$$\frac{\partial A}{\partial r} = L_y\left\{\pi_1\left[-we^{-rw} + (1-t_y)we^{-r(1-t)w}\right] + (1-\pi_1)\tau(1-e^{-r\tau})\right\} \qquad (21)$$

where the second term is always positive. Thus (21) is positive if an only if:

$$\begin{aligned}(1-t_y)we^{-r(1-t)w} &> we^{-rw}\\ (1-t_y)e^{-r(1-t)w} &> e^{-rw}\\ (1-t_y)\frac{e^{rt_yw}}{e^{rw}} &> \frac{1}{e^{rw}}\\ (1-t_y)e^{rt_yw} &> 1\\ (1-t_y)rt_yw &> 0\end{aligned}$$

which is always true if $r > 0$. Since the same results is obtained for the second term of equation (20) (the only difference is that instead of t_y, there is t_x), it follows that the higher the risk aversion the higher the welfare gain of Welfare State under free trade.

Let now consider the effect of an higher level of the free trade price. An increase of the wage rate has an opposite effect on A and B. From equation (5), it follows that an increase in the specialization level reduces t_y but it increases t_x, making B to decrease. But, since for high levels of risk aversion, the increase of t_x is more relevant than the decrease of t_y it follows that:

$$\frac{\partial\Omega}{\partial r} < 0$$

i.e. as specialization increases the benefit of welfare State under free trade tends to decrease.

Proof of Proposition 4 Consider the difference between the gains from specialization and the gains from insurance, i.e. the difference between aggregate welfare under free trade and autarky with the welfare State:

$$\begin{aligned}\Theta &= W^{ft} - W^a_{tax}\\ &= L^{ft}_y\left[E\left(U^{ft}_y\right)\right] + L^{ft}_x\left[E\left(U^{ft}_x\right)\right] - L^a_y\left[E\left(U^a_{y,tax}\right)\right] - L^a_y\left[E\left(U^a_{x,tax}\right)\right]\\ &= L^{ft}_y\left[\pi_1\left(1-e^{-rw_{ft}}\right)\right] + L^{ft}_x\left[(1-\pi_1)\left(1-e^{-rw_{ft}}\right)\right]\\ &\quad -L^a_y\left[\pi_1\left(1-e^{-r(w_a-\tau)}\right) + (1-\pi_1)(1-e^{-r\tau})\right] - L^a_x\left[\pi_1\left(1-e^{-r\tau}\right) + (1-\pi_1)\left(1-e^{-r(w_a-\tau)}\right)\right]\end{aligned}$$

Assume, for simplicity, that the two states of the world are equi-probable. I obtain:

$$\begin{aligned}\phi &= 2\left(1-e^{-rw_{ft}}\right) - 2\left[1-e^{-r(w_a-\tau)}\right] - 2\left(1-e^{-r\tau}\right)\\ &= -e^{-rw_{ft}} + e^{-r(w_a-\tau)} - 1 + e^{-r\tau} \qquad (22)\end{aligned}$$

Differentiating (26) with respect to w_{ft}, I obtain

$$\frac{\partial \phi}{\partial w_{ft}} = \frac{r}{e^{rw_{ft}}} > 0$$

thus, the benefit of free trade increases with specialization. Since ϕ increases with w_{ft}, let assume, in the last part of the proof I assume that $w_{ft} = w_a$. To see the effect of higher risk aversion on the relative benefits of specialization and insurance I calculate:

$$\begin{aligned} \frac{\partial \phi}{\partial r} &= w_{ft}e^{-rw_{ft}} - (w_{ft} - \tau)e^{-r(w_{ft}-\tau)} - \tau e^{-r\tau} \\ &= \frac{w_{ft} - w_{ft}e^{r\tau} + \tau e^{r\tau}}{e^{rw_{ft}}} - \frac{\tau}{e^{r\tau}} = \frac{e^{r\tau}\left[w_{ft} - w_{ft}e^{r\tau} + \tau e^{r\tau}\right] - \tau e^{rw_{ft}}}{e^{rw_{ft}}e^{r\tau}} \end{aligned} \tag{23}$$

Since the denominator is always positive, the sign depends only on the numerator:

$$e^{r\tau}\left[w_{ft} - w_{ft}e^{r\tau} + \tau e^{r\tau}\right] - \tau e^{rw_{ft}}$$

Given that $e^{rw_{ft}} > e^{r\tau}$, the sign of (23) is negative if $[w_{ft} - w_{ft}e^{r\tau} + \tau e^{r\tau}] < \tau$. Rearranging it I obtain:

$$\begin{aligned} [w_{ft} - w_{ft}e^{r\tau} + \tau e^{r\tau}] - \tau &< 0 \\ [1 - e^{r\tau}](w_{ft} - \tau) &< 0 \end{aligned}$$

which is always true. It follows that (23) is always negative.

Chapter 4

Uncertainty, Trade Integration and Optimal Protection in Ricardian Model with a Continuum of Goods

4.1 Introduction

The process of globalization of production that has taken place in the last two decades has been accompanied by increasing concern about its economic and social effects. Even if by now thousands of theoretical and empirical papers have analyzed the many issues involved, the debate on the economic benefits and cost of increasing trade integration is still open. Limiting ourself to the discussion about its the static effects, there are two main positions in the profession. On one side, there are the ones that emphasize the large gain in allocational efficiency that would result from free international exchange. On the contrary, others points to a series of possible negative consequences of increasing trade openness, among which the most important are higher income inequality and income risk. But, while the literature on the allocation and distributional effects of trade is by now extremely vast, the one on the effect of trade openness on individual income volatility is much more scant.[1]

This paper, introducing uncertainty in the classical Ricardian continuum of goods model and focusing on the effects of trade integration on individual welfare, is a contribution to this latter line of research. In the standard (deterministic) Ricardian continuum of goods model, higher trade integration increases efficiency in both country and world production and benefits consumers via the consequent price reduction. Thus, whatever it is its initial level, a tariff reduction is always welfare increasing

[1]Until now, the only paper that has addressed this question from an empirical point of view is Krebs et alt. (2005).

and the optimal level of protection is zero. The present model formalize the intuition that, instead, if there is uncertainty and jobs are characterized by a positive level of specificity, changing the level of protection entails *both* costs and benefits.

The presence of this *trade off* is captured in the model in a very simple way. In each period the realization of a stochastic variable determines the range of domestically produced varieties. The presence of uncertainty concerning country's comparative advantages implies that in each period there is a positive probability for workers to be displaced. The latter it is higher 1) the lower the difference in the relative sectoral productivities between the foreign and the domestic country; 2) the closer the sector the worker is employed into is to the *borderline* one. In case of displacement, since each job is characterized by a positive degree of specificity, the worker suffers a loss because moving from her sector to another one is costly. Under the assumption that the more (fewer) the sectors, the lower (higher) the cost to find a new job when displaced, I obtain the full characterization of the effect of higher trade integration on worker's expected income. The main result of the paper is that, depending on the economic structural characteristics of the country and under proper limitation of the parameters' space, increasing trade integration may decrease expected utility.

There are two main sources of inspiration for the present work. The first is the trade under uncertainty literature. Since the pioneering contribution by Brainard and Copper (1968), this line of research has derived a series of important (because unconventional) theoretical propositions, most of which are in open contradiction with classical ones. As it is well known, one of the fundamental result of classical trade theory is that under perfect competition and in the absence of external economies, free trade leads, through promoting proper specialization, to efficiency in world production (MacKenzie, 1954; Dornbusch et alt. 1977). But under uncertainty this is not more true. Indeed, under uncertainty the optimal country specialization level is lower than in a deterministic setting and trade theorems (i.e. the factor-price equalization theorem, the Stolper-Samuelson theorem, the Rybczynski theorem, Heckscher-Ohlin theorem, etc..) do not hold in the absence of complete international asset market[2]. In addition Kemp and Liviatan (1973), Ruffin (1974) and Turnovsky (1974) demonstrated that in a Ricardian two-sector model the (optimal) pattern of trade does not need to follow comparative cost advantages, and thus that the doctrine of comparative advantages does not work properly under uncertainty. But, no attempt has been made to link these results to how the presence of uncertainty modifies the effect of increasing trade integration on

[2]For excellent surveys of these results see Helpman and Razin (1978) and Hoff (1994).

individual well-being[3]. One of the objectives of this paper is indeed to fill this gap.

The second source of inspiration for this paper is the literature on the optimality of government intervention in a trade context under uncertainty. Eaton and Grossman (1985) pioneered this literature exploring the use of government-imposed trade tariff protection as a substitute for missing insurance markets. They show that, in the presence of a specific factor and with incomplete markets for contingent claims, free trade is not optimal and that government can improve social welfare by using commercial policy (i.e. tariffs on imports). Government intervention can also be the instrument to achieve the optimal level of specialization. Brainard (1991) presents a two-sector Ricardian model with specific workers in which taxes and transfers can be used to induce risk averse workers to specialize optimally from a social point of view, a result that would not be achievable in the absence of government intervention. Bowles and Pagano (2006) emphasizes how the degree of worker's specificity is an important variable to determine her preferences in choosing between higher trade integration or stronger government intervention in the economy, i.e. through the provision of a tax-based insurance mechanism. All these models thus show that a case in which government intervention may be welfare increasing is when (at least) one of the production factors is characterized by a positive degree of specificity. A peculiar feature of the present model is that, differently from previous ones, the degree of worker's specificity is *endogenously* determined in the model and depends on the specialization level of the country. Furthermore the change in the number of active sectors in the economy also modifies the worker's income risk: *ceteris paribus*, a smaller number of domestic active sectors increases the variance of workers' income. Finally, worker's level of risk exposure also depends on its occupational sectoral location[4]. In the model, protecting the economy with an import tariff is costly in that there is no full exploitation of the possible efficiency gains and of the related price reduction. But protection also reduces income loss in case of displacement and thus increases expected welfare of workers[5].

The Ricardian continuum of goods model has been widely used in the literature

[3]While some authors have emphasized the stabilizing effect (of both prices and quantities) of more integrated and larger product markets, Rodrik (1997) shows that, when stronger foreign competition increases the elasticity of labor demand functions, any given shock would translate into larger variations in wages and employment and thus in more volatile incomes.

[4]Empirical results for the Mexican case show that trade policy changes have a significant short run effect on income risk for industries with high levels of import penetration. Krebs et alt. (2005) calculate that a 5% tariff reduction the standard deviation of the persistent shocks to income by about 25%.

[5]While in Eaton and Grossman (1985) tariff revenues are used to compensate workers employed in the unlucky sector, in this model, on the contrary, the only effect of tariff protection is the provision of a larger number of active sector, that work as a risk reducing device in case of negative shock affecting *all* sectors.

but mostly in a deterministic setting[6]. To the best of my knowledge, this is the first stochastic version of it that it is used to analyze the effects of higher trade integration on individual welfare. While the result that under uncertainty higher trade integration may lead to lower welfare is not novel to the literature (Newbery and Stiglitz, 1984), the original contribution of this paper is to provide a simple model in which the benefits and cost of increasing trade integration are modeled together and to derive the conditions under which an *optimal* positive level of protection exists.

The paper is structured as follows. In Section 4.2, the building blocks of the model are presented. In Section 4.3, I describe the effects of increasing trade integration on individual welfare and the two main results of the paper are derived and discussed. Section 4.4 concludes.

4.2 The model

In this section I present a variant of the classical Ricardian continuum of goods model modified by the introduction of uncertainty[7].

4.2.1 Supply

Consider two countries, South and North. Both countries can produce a set of goods indexed by z, modeled as a continuum on an unit interval. Thus we have $z \in [0,1]$. In South the production of sector z is described by a Cobb-Douglas production function

$$Y_z = a(z)K_z^{\alpha}L_z^{1-\alpha} \tag{1}$$

where $a(z)$ is the sector specific productivity parameter.

Perfectly competitive firms produce variety z combining capital (K) and labour (L) using the constant return to scale technology (1), so that the producers of variety z choose K_z and L_z to maximize their profits

$$\Pi_z = p_z a(z)K_z^{\alpha}L_z^{1-\alpha} - w_z L_z - rK_z$$

where $\alpha \in [0,1]$, w_z is the wage rate paid in sector z, and r is the exogenously given

[6]Eaton and Kortum (2002) provide a multi-country stochastic version of the Ricardian continuum of goods model. The present model differers from that because I model uncertainty in a different way and the focus is on individual welfare rather than on trade flows.

[7]More precisely I introduce uncertainty in the Imbs and Warcziarg (2000) version of the Dornbusch et alt (1977) model.

world rate of interest. Optimizing firms chose the optimal level of capital and labour. The optimal labour capital ratio is sector z is given by:

$$\frac{L_z}{K_z} = \frac{1-\alpha}{\alpha}\frac{r}{w_z} \tag{2}$$

For the sake of simplicity, I make the following:

Assumption 1 *Capital flows into the economy as to maintain full employment.*[8]

Substituting (2) into the FOC for the maximisation of profits, the South's price for each variety of the continuum is determined and it is given by

$$p_z = \frac{1}{a(z)}\frac{r}{\alpha}\left(\frac{r}{w_z}\frac{1-\alpha}{\alpha}\right)^{\alpha-1} \tag{3}$$

Assume that production technologies are identical but for the sectors specific parameter and that that $a(z) \neq a^*(z)$ for all z, where $a^*(z)$ is North's sector specific productivity parameter. Rank the goods in order to have $A'(z) < 0$, where $A(z) = \frac{a^*(z)}{a(z)}$. This simply means that the goods are ranked from the one in which the South productivity comparative advantage is lower to the one in which it is higher.

Assume now that the comparative advantages, differently from the standard model, are stochastic (or, alternatively, that they not perfectly known by the agents). Since only relative productivities matter, I assume that South productivity is deterministic (perfectly known), while the one in North it is not. I model this uncertainty in the form of a multiplicative parameter $\theta \sim N(1, \sigma)$. Thus I have

$$A(z) = \frac{\theta\, a^*(z)}{a(z)} \tag{4}$$

Note that the higher θ, the higher North relative productivity.

[8]If capital was constant, any reduction in the tariff protection would produce unemployment. As it I will show below (section 4.2.4), a reduction of t (and thus an increase of z_i) implies an increase of w_z. It follows that in each 'ex-post' active sector the equilibrium wage rate is higher and (from equation (2)) labour demand is lower. This implies that total labour demand L_d defined as

$$L_d = \int_{z_i}^{1} L_z dz$$

decreases, *ceteris paribus*, with trade integration. Note that since I am deriving the minimal conditions under which a tariff reduction is welfare improving, Assumption 1 makes the case for increasing trade integration easier, not more difficult. Indeed, if this assumption did not hold the *cost* of reducing tariff protection would be larger.

Assumption 2 *The stochastic parameter θ does not modifies the rank of the comparative advantages. Any realization of θ shifts the whole comparative advantage curve $A(z)$.*

4.2.2 Demand

In order to minimize the effects of demand driven phenomena, I assume that all the agents are characterised by Leontief preferences over the different varieties. This implies that the demand for each good is the same. Agents derive utility from the consumption of all varieties and the domestic and foreign produced goods of the same variety are perfect substitute.

Each period, agents in South choose $\mathbf{X} = [X_z]$ (the vector of consumption) to maximize:

$$min\,(X_0, \ldots, X_1)$$

$$s.t. \quad \int_0^{z_i} (1+t)\frac{p_z^*}{\theta} X_z dz + \int_{z_i}^1 p_z X_z dz = Y_s$$

where the symbol * refers to the foreign country's variables, p_z is the domestic price of good z, X_z is the consumption of good z, t is South import tariff, Y_s is total South nominal expenditure and z_i is the threshold goods that determines the import set. The domestic economy produces all the varieties belonging to the interval $[z_i, 1]$. Note that the uncertainty concerning foreign competitiveness implies that both z_i and Y_s are stochastic. Since their actual values depend on the realization of θ, also P is a stochastic variable. Given Leontief preferences, for all z, $X_z = X$ and the budget constraint becomes $PX = Y_s$, where

$$P = \int_0^{z_i} (1+t) E\,(p_z^*)\, dz + \int_{z_i}^1 p_z dz$$

is the domestic price index and $E(\cdot)$ the expectation operator. By analogy, in the foreign country the budget constraint reads:

$$X^* \left[\int_0^{z_e} E\,(p_z^*)\, dz + \int_{z_e}^1 (1+t^*) p_z dz \right] = Y^*$$

where $[0; z_e]$ represent the range of foreign produced goods.

4.2.3 The specialization pattern

South imports good z if and only if $p_z > (1+t)\frac{p_z^*}{\theta}$, where t is an uniform *ad valorem* tariff. The equality defines the Souths borderline import good z_i. Assuming $p_z^* = \Gamma$ we have that:

$$p_z = (1+t)\frac{\Gamma}{\theta}$$

$$a(z) = \frac{1}{(1+t)}\frac{r}{\alpha}\left(\frac{r}{w_z}\frac{1-\alpha}{\alpha}\right)^{\alpha-1}\frac{\theta}{\Gamma}$$

If $a(z)$ is an invertible function, the borderline good is given by:

$$z_i = a^{-1}\left[\frac{1}{(1+t)}\frac{r}{\alpha}\left(\frac{r}{w_{z_i}}\frac{1-\alpha}{\alpha}\right)^{\alpha-1}\frac{\theta}{\Gamma}\right] \tag{5}$$

This expression determines the threshold good z_i. South imports all the varieties in the range $[0, z_i]$. From (5) it immediately follows that

$$\frac{\partial z_i}{\partial \theta} > 0 \qquad and \qquad \frac{\partial z_i}{\partial t} < 0 \tag{6}$$

Thus, for given wage rate, the higher θ the smaller the set of goods for which South enjoys a comparative advantage, i.e. the smaller the set of domestically produced goods. If t decreases (i.e. South increases its openness), z_i increases, i.e. the number of imported varieties increases and the number of the domestically produced ones decrease. In a Ricardian model with a continuum of goods, this is equivalent to say that if t decreases the specialization level of South increases.

In a specular way, it is determined the range of exported goods. Since the focus of the paper is on South's trade policy behavior, in the following it assumed that North is already totally opened, i.e. $t^* = 0$. This implies that South exports good z if and only if $p_z < \theta\Gamma$. The equality defines the Souths borderline import good z_e. Thus,

$$p_z = \frac{\Gamma}{\theta}$$

$$a(z) = \frac{r}{\alpha}\left(\frac{r}{w_z}\frac{1-\alpha}{\alpha}\right)^{\alpha-1}\frac{\theta}{\Gamma}$$

Finally, if $a(z)$ is invertible, I can write:

$$z_e = a^{-1}\left[\frac{r}{\alpha}\left(\frac{r}{w_{z_e}}\frac{1-\alpha}{\alpha}\right)^{\alpha-1}\frac{\theta}{\Gamma}\right]$$

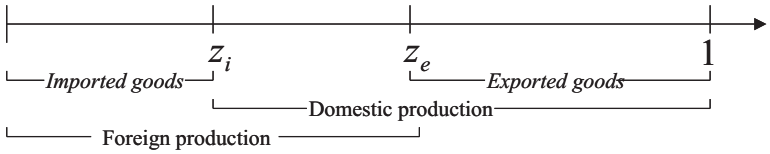

Figure 4.1: The continuum of goods and the international division of labour

Thus this expression determines the threshold good z_e. South will export varieties in the range $[z_e, 1]$. It is clear that for $t > 0$ we have that $z_e > z_i$. This implies that there is a range of non-traded goods $[z_i, z_e]$ that both countries produce but that they do not trade (see 4.1). The impact of a reduction of t is indeed the contraction of this latter set of goods.

4.2.4 Sectoral equilibrium wage

Sectors are differently exposed to risk. Indeed the closer sector z is to the borderline sector z_i, the higher the risk for the worker employed into z to loose her job. This happens any time the ex-post price of any of the goods belonging to the continuum is higher (including also the worker's mobility cost) in South than in North. This is obviously increasingly more likely the smaller the cross-country difference in sectoral productivities, i.e. the closer the sector is to the borderline variety.

This implies that, as in Bowles and Pagano (2006), in this model uncertainty takes the form of the occurrence of either a status quo state, in which the individual continues to work in her sector earning a wage w_z, or a bad state in which there is no demand for the good produced in the sector the worker is employed in. In the latter case the worker must move to another sector. There her wage will be $(1 - s)w_z$ where s is a measure of the degree to which her skills are specific to the initial livelihood[9].

The realization of the stochastic variable produces the displacement of the workers only if it is sufficiently high[10]. The cut-ff value is[11]:

$$\theta > \bar{\theta} = (1 + t)\frac{a(z)\Gamma}{w_z - a(z)s} \tag{7}$$

The value of θ for which there is displacement is, as expected, higher i) the higher the value of North's price; ii) the higher South's productivities, iii) the lower (i.e. the more competitive) is South's wage.

[9]Indeed, acquiring the (new) skills appropriate in the destination sector may be costly and time consuming, and that may take the form of foregone wages (Dennis and Iscan, 2005). On this see also Krebs et alt (2005).

[10]Were the wages assumed to be rigid downward, there would be displacement for $\theta > 1$.

[11]See the Appendix 1 for the derivation.

Since the focus of the model is on how the changes in the specialization pattern provoked by the presence of uncertainty affects individual welfare, I limit the analysis to case in which $\theta > \bar{\theta}$. In this case, expected income in sector z is:

$$E(I_{hz}) = \pi w_z + (1-\pi)(1-s)w_z \tag{8}$$

where I_h is income of individual h, π is the probability of the status quo and s is a measure of specificity.[12] The variance of her realized income is:

$$Var(I_{hz}) = \pi(1-\pi)(w_z s)^2 \tag{9}$$

Workers in South are risk neutral and identical, thus their preferences can be conviniently be represented by a linear utility function. They are indifferent to the sector to be employed into if and only if their expected utility of income is equalized among the different sectors. Given the general equilibrium nature of the model (captured by the balance of payment equilibrium condition), at least one sector in South is always active, independently from the realization of θ. This sector is sector $z = 1$. This implies that the sectoral wage there, i.e. w_1 - is not random. For the sake of simplicity, also assume that its level is exogenously given[13]. Thus the equilibrium allocation condition reads:

$$\begin{aligned} E[U(I_i)] &= E[U(I_j)] \\ w_1/P &= \pi(w_z/P) + (1-\pi)(1-s)(w_z/P) \end{aligned} \tag{10}$$

If condition (10) does not hold no worker would accept working in sector z. The equilibrium condition entails a compensation for risk. The lower z, the lower the (margin) of comparative advantage of South. This increases the probability that, for given positive realization of θ, the relative North productivity is higher, making good z an import rather than an export for South.

[12] A more complicated but general formulation can be:

$$E(I_{hz}) = \pi w_z + (1-\pi)\hat{w}_{-z}(1-s)$$

where

$$\hat{w}_{-z} = \int_{z_i}^{1} \phi_z w_z dz$$

where ϕ_j is the probability to go sector z and w_z is sectoral wage. As it will be shown later, since wages include a compensation for risk to equalize expected utilities of workers in different sectors, the wages are all 'equal' and thus the wage in the destination sector (whatever it is) is equivalent to w_z.

[13] For instance, one can assume that it is the result of a bargaining process (for simplicity not modeled here) between capitalist and workers.

Solving for the equilibrium sectoral wages it yields:

$$w_z = \frac{w_1}{(1-s)+\pi s} \tag{11}$$

Note that for $s = 0$, $w_z = w_1$. This means that, if agents are not specific, wages are equalized across sectors and the model collapses in the standard Ricardian continuum of goods model. In addition, if $\pi_1 = 1$ $w_z = w_1$, i.e. if the probability of displacement is zero, wages are equalized across sectors.

The effect of changes in the parameters on the equilibrium sectoral wage are straightforward and intuitive. The sectoral equilibrium wage is higher: 1) the lower π; 2) the higher w_1; 3) the higher the specificity of workers[14]. Note that (11) implies

$$E(I_{hz}) = w_1$$

and that:

$$\frac{\partial Var(I_{hz})}{\partial s} > 0$$

i.e. the variance of income increases with specificity.

In North workers are risk neutral and thus there is only one common wage for all sectors, w^*.

I now add some more structure to the model in order to analytically evaluate the effects of a reduction in the tariff level on welfare.

Specificity I assume that the specificity is a *decreasing* function of the number of sectors. The intuition of this assumption is as follows. Since worker h is specific to her sector, this implies that when she had to move to a new job because of a bad state, part of her competencies will be useless in the new sector. Thus her new wage will be lower. In a similar way we can think about the time spent searching for a new job. If production specialization is strictly related to spatial specialization, when a sector disappears this implies that workers have to physically move towards another location. Since as z_i increases, the range of domestically active sectors decreases, the simple intuition is that the higher z_i the higher the average the *technological distance* worker h has to travel to find a new job. The same holds if production specialization is correlated with regional specialization. Thus, leaving a sectors implies 'physical'

[14]Differentiating (11), it yields:

$$\frac{\partial w_z}{\partial s} = \frac{w_1(1-\pi)}{[1-s(1-\pi)]^2} > 0$$

moving costs. To capture both these aspects in the model, I assume that the income loss is decreasing in the number of domestic active sectors. Formally:

$$s = f(z_i)$$

with

$$\frac{\partial s}{\partial z_i} > 0 \tag{12}$$

The simplest functional form that satisfies (12) is

$$s = z_i \tag{13}$$

Equation (13) states that if z_i increases, the wage loss in case of bad state increases. - oppure the variance of income is higher

Probability of displacement The equilibrium sectoral wage depends also on the probability of displacement $(1 - \pi)$. In particular, the closer sector z is to the borderline one, the higher the probability that it can be wipe-out by foreign competition. I incorporate this feature explicitly in the model assuming that the probability of displacement is sectoral dependent. In particular I assume that

$$\frac{\partial \pi}{\partial z} > 0$$

This probability clearly depends on the realization, i.e. if $\theta > th\bar{e}ta$, from the shape of the A curve and from the sector the worker is employed into. Choosing a specific functional form:

$$\pi_z = f(z) = \gamma z \tag{14}$$

where $0 < \gamma < 1$ is a positive constant. Equation (14) states that the probability of being displaced decreases as we move toward the sectors in which South has stronger comparative advantages. Note that the chosen functional form allows for across country comparisons. *Ceteris paribus*, if a country is characterized by a higher γ, this means that for given shock the probability that workers have to leave any sector is lower. Indeed γ implicitly describes different patterns of relative comparative advantages (i.e. different slopes (shapes) of the $A(z)$ curve). This obviously implies that the equilibrium sectoral wage rate is a decreasing function of γ.

Substituting (13) and (14) into (11), the equilibrium sectoral wage can be rewritten as:

$$w_z = \frac{w_1}{(1 - z_i) + \gamma z z_i} \tag{15}$$

Here they are evident the conflicting effects of a reduction of t, i.e. of an increase of specialization. On the one hand a reduction of the protection increases the average wage w_z due to the increases of s. On the other since π_z depends positively on z_i a reduction of t reduces the equilibrium wage (because the probability of remaining in the 'survived' sectors is *now* higher) making the economy more competitive.

4.2.5 Trade equilibrium

Under the assumption of Leontief preferences the per period trade balance condition reads

$$\int_{z_e}^{1} p_z X^* dz = \int_{0}^{z_i} (1+t)\frac{\Gamma}{\theta} X dz$$

Under uncertainty it is clear that the equilibrium can be only in expected terms.

4.2.6 Price index

Recall that the price index has been defined as:

$$P = (1+t)\frac{\Gamma}{\theta} z_i + \int_{z_i}^{1} p_z dz \tag{16}$$

The first term on the right-hand side represents the component of the price index that depends on the price and number of imported varieties. The second one refers to the domestic component of the index and is given by the integral of the prices paid for domestically produced goods.

Substituting equation (3) and (5) into (16) the expected domestic price index can be rewritten as[15]:

$$P = \Phi \left[w_{z_i}^{1-\alpha} + \int_{z_i}^{1} \frac{w_z^{1-\alpha}}{a(z)} dz \right]$$

where Φ is a positive constant.

4.3 Optimal protection

In the standard Ricardian continuum of goods model the optimal level of the tariff is zero. Since the model is based on comparative advantages and there is perfect competition, free trade is always optimal. Indeed free trade, allowing the efficient

[15] See Appendix 1 for the derivation.

allocation of world production, maximizes both country and world welfare. Any tariff protection would distort the optimal international division of labour reducing income.

In the presence of uncertainty and specificity of workers this is not true anymore. Differently from what happens in the deterministic case, under uncertainty reducing trade protection has both a positive and negative effect on workers' utility. Indeed there is a trade-off between higher average expected wage and higher variance - where the latter is the consequence of an increase in the specialization level. When the 'variance' effect is stronger than the efficiency gains effect, free trade is not optimal and a positive level of protection is welfare increasing. Using the simple model I have introduced in the previous section, in the following I derive the conditions under which the optimal level of protection is positive.

Positive effect: price index reduction Tariff reduction has two opposite effects on the price index. The first is a (direct) positive one: the set of imported varieties $[0; z_i]$ becomes less expensive if t decreases. But at the same time, as t decreases z_i increases, enlarging the number of varieties that are imported. In order to determine the net effect of a reduction of protection on the domestic price index, I need to derive a closed analytical expression for P. For this reason I have to assume an explicit functional form for the pattern of sectoral labour productivities in South. For simplicity let $a(z) = z$. Thus the price index is South reads[16]:

$$P = \Phi \left[w_{z_i}^{1-\alpha} + \int_{z_i}^{1} \frac{w_z^{1-\alpha}}{z} dz \right] \tag{17}$$

To begin with, note that the second term in the right-hand side of equation (17) is always decreasing with a tariff reduction, because (from (6)) a lower t implies a higher z_i. Then I consider the first term. This part of the equation captures the cost associated with importing foreign produced varieties on which South impose a tariff. Recalling the expression for sectoral wage (equation 15) and differentiating it with respect to z_i, I obtain:

$$\frac{\partial w_{z_i}^{1-\alpha}}{\partial z_i} = w_1^{1-\alpha} \frac{(1-\alpha)\left[1 - 2\gamma z_i\right]}{\left[(1-z_i) + \gamma z_i^2\right]^{2-\alpha}} \tag{18}$$

[16]Assuming $a(z) = z^{\beta}$ equation (16) would become

$$P = \left[(1+t)\frac{\Gamma}{\theta} \right]^{\frac{\beta-1}{\beta}} w_{z_i}^{\phi} + \int_{z_i}^{1} \left(\frac{w_{z_i}^{\phi}}{z} \right)^{\beta} dz$$

Since the sign of (18) depends only on the sign of numerator we have:

$$\frac{\partial w_{z_i}^{1-\alpha}}{\partial z_i} > 0 \qquad iff \qquad (1-\alpha)\left[1-2\gamma z_i\right] > 0 \tag{19}$$

The condition for which an increase in specialization reduces the first term of (17) is given by:[17]

$$z_i^* > \frac{1}{2\gamma} \tag{20}$$

where z_i^* gives the lower bound value of the borderline goods sufficient for a tariff reduction to lower the price index. Under the restriction $\gamma < 0.5$, the first term of (17) is always increasing with z_i.[18] This result means that if the probability of displacement is very high, it is possible that the effect of trade integration is an increase in the domestic price level.

Here we have a clearly non linear relationship between the tariff level and the price index. Indeed, note that $\frac{\partial z_i^*}{\partial \gamma} < 0$ and thus the lower the γ the higher z^*, i.e. the minimum level of z for which a decreases in protection reduces the price index. In other words if γ is lower there is a smaller range of specialization starting points for which liberalization in beneficial, i.e. a reduction in the tariff level reduces the domestic price index. If on the contrary γ is very high it is 'easier' that the country benefits from liberalization. In addition note that, *ceteris paribus*, an higher γ implies a larger reduction of the price for any increase of specificity, i.e. more benefits from tariff reduction. Indeed, the higher γ, the lower the price index for each given level of specialization z_i.

In the standard Ricardian continuum of goods model, the specialization-induced reduction of the price index is the channel trough which higher trade integration yields higher real wages and aggregate income (see for a similar result Andersen and Skanksen, 2005). In this model, the same positive effect is present but it is parametrically restricted. Thus, if equation (20), that states the sufficient condition for the price index to decrease after tariff reduction, is satisfied I always have that:

$$\frac{\partial P}{\partial t} > 0 \tag{21}$$

Consider now the expected income change following a tariff reduction. Given the

[17] See Appendix 1.

[18] Note that (20) imposes a lower bound to the value of γ. The necessary condition for $z_i^* < 1$ is $\gamma < 0.5$.

equilibrium condition I have

$$\frac{\partial E(I_{hz}/P)}{\partial t} = w_1 \left(\frac{\partial P}{\partial t}\right)^{-1} < 0$$

This implies that as the tariff decreases expected workers' income increases. Thus considering just expected income the optimal level of tariff would be $t^* = 0$, where the country produces only the goods in which it has a comparative advantage.[19]

Negative effect: increase of variance As we have seen the positive effect of reducting tariff is given by the reduction of the price index. This increases workers' real wage. I have also shown that this positive effect is higher the higher γ, i.e. the steeper the function $A(z)$. This implies that the more different are the two countries, the higher the benefit.

I now consider the negative effect of reducing protection. This is related to the fact that the number of active domestic sector decreases, increasing the wage loss in case of displacement.

Using equation (9) and the assumed functional form for specificity and probability of displacement (equations (13) and (14)), I have

$$Var(I_{hz}/P) = \pi_z(1-\pi_z)[(w_z/P)s]^2 = \gamma z(1-\gamma z)\left[\frac{w_1/P}{(1-z_i)+z\gamma z_i} z_i\right]^2$$

with

$$\frac{\partial Var(I_{hz}/P)}{\partial z_i} = \gamma z(1-\gamma z)\left[\frac{-2(w_1/P)^2 z_i^2(-1+\gamma z)}{(1-z_i+\gamma z z_i)^3} + \frac{2(w_1/P)^2 z_i}{(1-z_i+\gamma z z_i)^2}\right] > 0$$

Simple comparative statics shows that the variance is higher if γ is lower. In addition, as expected, workers employed in sectors farther from the safe one suffer, for a given reduction of tariff protection, a larger increase in income variance. This is so because of the higher effect of the reduction of 'available' sectors on the income variance of borderline workers. This is shown by the fact that the lower the z the higher the variance of income.

4.3.1 Tariff reduction and expected utility

Now consider what is the effect of increasing specialization the expected utility of a worker employed in sector z. To combine the two effects (i.e. the price and variance

[19] In this case optimal tariff under uncertainty coincides with the one in the deterministic case.

effect), substitute (13) and (14) into equation (8), to obtain

$$E(U_z) = E\left[z(w_z/P) + (1-z)(1-z_i)(w_z/P)\right] \tag{22}$$

Slow adjustment

Lets begin considering the case in which the sectoral wage adjust with a lag to the (ex-post) new equilibrium. In this case w_z is assumed not to change with t. Deriving (22) with respect to t, it yields:

$$\frac{\partial E(U_z)}{\partial t} = \left[z w_z \left(\frac{\partial P}{\partial t}\right)^{-1} - \frac{\partial z_i}{\partial t}(1-\pi)\frac{w_z}{P} + (1-z)(1-z_i)w_z \left(\frac{\partial P}{\partial t}\right)^{-1} \right] \tag{23}$$

Note that the two last terms in the right hand side of the equation represent the component of cost related to the positive probability of displacement

The following propositions contain the two main results of the paper.

Proposition 1 *Define* $\phi \equiv \left(\frac{\partial P}{\partial t}\right)^{-1}$. *There exist a negative constant* $\bar{\delta}$ *such as,* $\forall \delta < \bar{\delta}$, *if* $\phi < \delta$ *the expected variation of income following a reduction of the tariff level is positive.*

Proof. See Appendix 2 ■

Proposition 1 states that the expected variation of income following a reduction in tariff is positive only if the reduction in the price index is sufficiently strong. Otherwise the negative effect of the increase in risk (due to the reduction of the number of active sectors) and the cost related to displacement make increasing trade integration welfare reducting.

The second result is contained in the following:

Proposition 2 *Define* $\tau \equiv \frac{\partial z_i}{\partial t}$. *If* $\phi < \left(\frac{1-\pi}{P}\right)\tau$ *the optimal tariff is positive.*

Proof. See Appendix 2 ■

Proposition 2 states that under uncertainty, in opposition to the deterministic case, the optimal level of protection t^* is not zero but it is indeed positive. The condition under which this is true is that the negative effect of the change in the number of domestically produced varieties (multiplied by a constant) is larger than the positive price effect. How the parameters affect the level of t^* it is described in the following:

Corollary 1 *The optimal level of protection is positive and has the form:*

$$t^* = t^*(\phi, \tau, z)$$

with

$$\frac{\partial t^*}{\partial \phi} < 0 \qquad \frac{\partial t^*}{\partial \tau} > 0 \qquad \frac{\partial t^*}{\partial z} < 0 \tag{24}$$

Proof. See Appendix 2 ■

The interpretation of the partial derivatives is easy and intuitive. The first states that the stronger the positive effect of a reduction of the tariff on the price index the lower the optimal level of tariff. The second means that, *ceteris paribus*, if the specialization pattern is very sensitive to changes in the tariff rate (i.e. foreign competition is very high), the optimal tariff is higher. The third states that the farther from the borderline sector is the one the worker is employed into, the lower the optimal tariff rate[20].

The results derived so far are based on the assumption that there is a lag between tariff reduction and wage adjustment. I now remove this restrictive (although not totally implausible) assumption.

Instantaneous adjustment

In the previous section we have assumed that agents do not internalize that a reduction of the tariff level would change also the equilibrium sectoral wage.

The changes in the wage rate are determined by two opposite forces. On the one hand, there is the effect of the reduction of the number of active sectors. A lower tariff level is associated with a smaller set of active sectors but the associated π (i.e. the probability to maintain the job in case of shock) would higher on average. All the survived sectors are indeed, due to the higher difference in the relative productivities, safer. Thus, this would reduce the level of the sectoral wage. On the other hand, increasing specialization increase the sectoral wage because of the reduction in s. Indeed, for compensating the higher loss the workers would suffer in case of displacement

[20]Note the difference between these results and the one presented in Fernandez and Rodrik (1991). In their paper, it is shown the existence of a *status quo bias*: under uncertainty concerning the distribution of gains and losses due to trade liberalization, rational forward looking agents may prefer not to open the economy. It is indeed possible that, even if the decision to opening to free trade would be (ex-post) beneficial to the majority, it may not be undertaken. The present model, on the contrary, does not compare free trade *vs* autarky. Instead it considers the determinants of the optimal level of protection and the conditions under which it is positive.

sectoral wages increases. In fact, due to risk compensation, the fewer sectors command a higher compensation for specificity.

The net results of these two effects depends on the model's parameters. While the case of an ex-post lower wage would just reinforce the previous results, this is not so obvious in the case the wage increases after trade integration.

Proposition 3 *A wage increasing process of trade integration reduces expected income if the effect of the reduction in the number of sectors is larger than the positive effect of price reduction. The higher the specialization level of the country, the more likely is that a further reduction of protection would reduce expected income.*

Proof. See Appendix 2 ■

Proposition 3 states that, even in the case in which the equilibrium sectoral wage increases following trade integration, if the effect of the reduction in the number of sectors is stronger than the positive effect of price reduction expected income can decrease because of lower trade protection.

4.4 Conclusions

This paper presented a simple model showing that, in a stochastic Ricardian model with a continuum of goods in which workers are partially specific, a positive level of protection may be optimal. While in the standard deterministic model reducing trade protection is always welfare increasing (and thus optimal protection is zero), here are derived the conditions under which, if comparative advantages are stochastic, this is not true anymore. The reason for this unconventional result is that under uncertainty there is a *trade-off* between the benefit and the cost of higher trade integration. In the present model, as in the standard one, the benefit comes in the form of a lower domestic price index that increases real wage. Instead, the cost of lower tariff protection is the increase of the average distance (and thus the wage loss) workers suffer when displaced. While the former effect increases expected real income, the latter increases its variance. The main result of the paper is the characterization of the optimal level of protection. This is the level of the tariff for which, given the status quo, a further increase of trade integration would produce benefits (i.e the price reduction) that are smaller than the its cost (i.e. higher income variance). It has been shown that the optimal level of protection depends on the structural parameters of the economy. *Ceteris paribus*, the smaller the price reduction induced by increasing trade integration, the higher the

optimal tariff. The optimal tariff is also increasing in the *overall* degree of foreign competitiveness: this implies that the more technologically similar are the countries, the higher is t^*. Finally, t^* depends on the worker's sectoral location; the lower the sectoral comparative advantage the higher the optimal level of protection.

This model provides a new application of the general result, coming from the literature of trade under uncertainty, that increasing specialization entails both benefits and costs. While in the deterministic setting only the firsts are present, under uncertainty the latter may be so relevant that increasing trade integration beyond a certain level may become welfare reducing. The assumption of risk-neutral workers implies that the cost of higher specialization does not depend on the degree of risk aversion but it is related to the risk of displacement. Thus, the cost *does* depend on the structural characteristic of the economy (i.t. the degree of specificity) and not on the preferences of the worker. As it is immediate to understand, were the workers risk averse, the models' results would just be reinforced. In addition, note that the models' results are quite robust because tariff revenues are not redistributed and thus are a pure waste.

This model shows that cases of opposition to the ongoing processes of higher trade integration may be easily justified once not only the benefits but also their costs are acknowledged. Recent estimation have shown that the positive effect of trade liberalization may be very small (Rodrik, 2006): this evidence supports the view that in many cases, in the absence of any compensating mechanism, it is well possible that (at least in the short run) costs may be bigger than benefits. It is thus evident that free trade cannot be 'dogmatically' assumed to be always optimal.

Two are the main predictions of the model. First, if the process of trade integration is characterized by an increasing international division of labour, it will encounter increasing opposition due to the fact that its costs increase with production specialization. Second, since, as the process of globalization proceeds, the cost of increasing trade integration (measured by s) is likely to rise more quickly in developing country rather than in developed ones, we should expect higher opposition to it there.

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Appendix 1

Derivation of $\bar{\theta}$ Since workers are specific, in case of displacement, they would incur in the (moving) cost s. If, after the shock, the wage reduction needed for the sector to remain competitive (and thus to continue producing good z) is smaller than the moving cost, they will accept a lower wage and will not leave the sector. On the contrary, workers will leave the sector if the difference in the prices (i.e. the wage reduction) is higher than the moving cost. Thus the 'worker's displacement' conditions reads:

$$\begin{aligned} p_z - (1+t)\frac{\Gamma}{\theta} &> s \\ \frac{w_z}{a(z)} - (1+t)\frac{\Gamma}{\theta} &> s \\ \theta\left[w - a(z)s\right] &> a(z)(1+t)\Gamma \\ \theta &> (1+t)\frac{a(z)\Gamma}{w_z - a(z)s} \end{aligned}$$

In addition:

$$\frac{\partial\theta}{\partial a(z)} = \frac{\Gamma\left[w_z - a(z)s\right] - a(z)\Gamma(-s)}{\left[w_z - a(z)s\right]^2} = \frac{\Gamma w_z}{\left[w_z - a(z)s\right]^2} > 0$$

Derivation of equation (17) Substituting equation (3) and (5) into (16), the expected domestic price index can be rewritten as:

$$\begin{aligned} P &= (1+t)\frac{\Gamma}{\theta}z_i + \int_{z_i}^{1} p_z dz \\ &= (1+t)\frac{\Gamma}{\theta}z_i + \int_{z_i}^{1} \frac{1}{a(z)}\frac{r}{\alpha}\left(\frac{r}{w_z}\frac{1-\alpha}{\alpha}\right)^{\alpha-1} dz \\ &= (1+t)\frac{\Gamma}{\theta}\left[\frac{1}{(1+t)}\frac{r}{\alpha}\left(\frac{r}{w_{z_i}}\frac{1-\alpha}{\alpha}\right)^{\alpha-1}\frac{\theta}{\Gamma}\right] + \frac{r}{\alpha}\left(r\frac{1-\alpha}{\alpha}\right)^{\alpha-1}\int_{z_i}^{1}\frac{w_z^{1-\alpha}}{a(z)}dz \\ &= \left[\frac{r}{\alpha}\left(r\frac{1-\alpha}{\alpha}\right)^{\alpha-1}\right]\left(w_{z_i}^{1-\alpha} + \int_{z_i}^{1}\frac{w_z^{1-\alpha}}{a(z)}dz\right) \\ P &= \Phi\left[w_{z_i}^{1-\alpha} + \int_{z_i}^{1}\frac{w_z^{1-\alpha}}{a(z)}dz\right] \end{aligned}$$

Also note that the first term can be re-written as:

$$w_{z_i}^{1-\alpha} = \left[(1+t)\frac{\Gamma}{\theta}\right]^{1-\alpha}$$

Differentiating with respect to t:

$$\frac{\partial\left[(1+t)^{\frac{\Gamma}{\theta}}\right]^{1-\alpha}}{\partial t} = \underbrace{\frac{(1+t)^{\frac{\Gamma}{\theta}}}{\partial t} z_i}_{>0} + \underbrace{(1+t)\frac{\Gamma}{\theta}\frac{\partial z_i}{\partial t}}_{<0} \tag{25}$$

Thus, the first term of equation (17) decreases with a tariff reduction if the first term on the right-hand side of equation (25) is larger than the second.

Derivation of condition (20) Evaluating (15) at z_i we have

$$w_{z_i} = \frac{w_1}{(1-z_i)+\gamma z_i^2}$$

Differentiating with respect to z_i it yields

$$\frac{\partial w_{z_i}^{1-\alpha}}{\partial z_i} = w_1^{1-\alpha}\left[(-1+2\gamma z_i)(\alpha-1)\left[(1-z_i)+\gamma z_i^2\right]^{\alpha-2}\right]$$

Thus the sign depends only on $(1-2\gamma z_i)$.

Appendix 2

Slow adjustment

Proof of Proposition 1

$$\begin{aligned}
\frac{\partial E(U_z)}{\partial t} &= z w_z \left(\frac{\partial P}{\partial t}\right)^{-1} - \frac{\partial z_i}{\partial t}(1-z)\frac{w_z}{P} + (1-z)(1-z_i) w_z \left(\frac{\partial P}{\partial t}\right)^{-1} > 0 \\
&= \left(\frac{\partial P}{\partial t}\right)^{-1} w_z\left[z+(1-z)(1-z_i)\right] - \frac{\partial z_i}{\partial t}(1-z)\frac{w_z}{P} > 0 \\
&= \left(\frac{\partial P}{\partial t}\right)^{-1}\left[z+(1-z)(1-z_i)\right] - \frac{\partial z_i}{\partial t}(1-z)\frac{1}{P} > 0 \\
&= \left(\frac{\partial P}{\partial t}\right)^{-1}\left[z+1-z_i-z+zz_i\right] > \frac{\partial z_i}{\partial t}\frac{(1-z)}{P}
\end{aligned}$$

Thus an increase in the tariff increase expected income if

$$\left(\frac{\partial P}{\partial t}\right)^{-1} > \frac{\partial z_i}{\partial t}\frac{(1-z)}{P}\frac{1}{1-z_i+zz_i}$$

Conversely, a reduction of the tariff increases expected utility of agent only if

$$\left(\frac{\partial P}{\partial t}\right)^{-1} < \delta$$

where

$$\delta = \frac{\partial z_i}{\partial t}\frac{(1-\pi)}{P}\frac{1}{1-z_i+zz_i}$$

i.e. the reduction in the price index is sufficiently large[21].

Proof of Proposition 2 The first order condition of equation (23) reads

$$\left(\frac{\partial P}{\partial t}\right)^{-1} - \frac{\partial z_i}{\partial t}\frac{(1-\pi)}{P}\frac{1}{1-z_i+zz_i} = 0$$

Defining as before $\left(\frac{\partial P}{\partial t}\right)^{-1} = \phi$ and $\frac{\partial z_i}{\partial t} = \tau$, it can be written:

$$\begin{aligned}\phi - \tau\frac{(1-\pi)}{P}\frac{1}{1-z_i+zz_i} &= 0\\ P\phi(1-z_i+zz_i) - \tau(1-\pi) &= 0\\ \phi P - z_i(\theta P - z) - \tau(1-\pi) &= 0\end{aligned}$$

Then

$$\phi P - z_i\phi P(1-z) - \tau(1-\pi) = 0$$

and finally

$$z_i^* = \frac{\phi P - \tau(1-\pi)}{\phi P(1-z)} \tag{26}$$

Note that the higher π the higher z_i^*, i.e. the lower the risk of displacement the higher the optimal level of specialization. Since from equation (6) we know that the borderline good is an inverse function of the tariff, we have that under uncertainty the optimal level of protection is positive.

Proof of Corollary 1 Trivial algebra shows that differentiating equation (26) it yields

$$\frac{\partial z_i^*}{\partial \phi} > 0 \qquad \frac{\partial z_i^*}{\partial \tau} < 0 \qquad \frac{\partial z_i^*}{\partial z} > 0$$

Since $\frac{\partial z^*}{\partial t^*} < 0$, this is sufficient to prove Corollary 1.

[21]Remember that both $\left(\frac{\partial P}{\partial t}\right)^{-1}$ and $\frac{\partial z_i}{\partial t}$ are negative quantities.

Instantaneuos adjustment

In this paragraph I derive the condition under which a reduction of the tariff increases expected income. Differentiating equation (22), I obtain

$$\frac{\partial E(U_z)}{\partial t} = \left\{ \underbrace{\frac{\partial w_z}{\partial t}\frac{\pi}{P}}_{<0} + \underbrace{\pi w_z \left(\frac{\partial P}{\partial t}\right)^{-1}}_{<0} + (1-\pi)\left[\underbrace{-\frac{\partial z_i}{\partial t}\frac{w_z}{P}}_{>0} + (1-z_i)\underbrace{\left(\frac{\partial w_z}{\partial t}\frac{1}{P} + w_z\left(\frac{\partial P}{\partial t}\right)^{-1}\right)}_{<0}\right]\right\} \tag{27}$$

This implies that a reduction in the tariff increases expected income (i.e. $\frac{\partial E(U_z)}{\partial t} < 0$) only if the reduction of protection does not reduce too much the number of active sectors (i.e. if $\frac{\partial z_i}{\partial t}$ is not too big). If this is not the cases, a reduction of the tariff would reduce expected income.

Note that the higher the specialization level, i.e. z_i, the higher should be larger should be the positive effect of price reduction for insuring that a reduction in protection would increase expected income. Finally note, on the contrary, that the higher $\pi = z$, the more difficult it is that a reduction in the tariff can decrease expected income. Thus the further the sector in which the worker is employed into is from the borderline one (i.e the higher the z) the more likely that a higher trade integration increases expected utility.

Appendix 3

Using an alternative formulation for equation (8)

$$E(I) = \pi w_z + (1-\pi)(1-s)\hat{w} \tag{28}$$

where

$$\hat{w} = \frac{1}{1-z_i}\int_{z_i}^{1} w_z dz$$

Since in this case it is not possible to derive an explicit expression for the equilibrium

wage, it is necessary to consider the implicit function:

$$\begin{aligned}\Phi &= \pi w_z - w_1 + (1-\pi)(1-s)\frac{1}{1-z_i}\int_{z_i}^{1} w_z dz \\ &= \pi w_z - w_1 + (1-\pi)(1-z_i)\frac{1}{1-z_i}\int_{z_i}^{1} w_z dz \\ &= \pi w_z - w_1 + (1-\pi)\int_{z_i}^{1} w_z dz\end{aligned}$$

Evaluating how the equilibrium wages changes with the level of specialization it yields:

$$\frac{\partial w_z}{\partial z_i} = -\frac{\frac{\partial \Phi}{\partial z_i}}{\frac{\partial \Phi}{\partial w_z}} = -\frac{<0}{>0} > 0$$

Thus, the behavior of the equilibrium wage when it is used equation (8) instead of equation (28) is the same.

Behaviour of the average wage

$$\begin{aligned}\hat{w} &= \frac{1}{1-z_i}\int_{z_i}^{1} w_z dz \\ &= \frac{1}{1-z_i}\int_{z_i}^{1} \frac{w_1}{(1-z_i)+z_i\gamma z} dz \\ &= \frac{w_1}{(1-z_i)\gamma z_i} log \frac{1+(\gamma+1)z_i}{1+(\gamma z_i - 1)z_i}\end{aligned}$$

Note that

$$\frac{\partial \hat{w}}{\partial z_i} > 0$$
$$\frac{\partial \hat{w}}{\partial \gamma} < 0$$

Thus the average wage increases with specialization and with the probability of displacement.