WEALTH INEQUALITY AND ECONOMIC PERFORMANCES

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Dedicated to my grandparents,

Baba and Ma

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Chapter 1

Introduction and Literature Survey

Ever since the inception of Development Economics as a separate discipline inequality has been a major area of extensive study. Economists and researchers have deliberated both on the causes and the effects of inequality in a wide range of treatise, books and essays. So far, in this regard, two fundamental approaches came across *viz.*, the Classical approach and the Credit Market Imperfection approach. The Classical approach was originated by Smith (1937) and was further interpreted and developed by Keynes (1920), Lewis (1954), Kaldor (1957), and Bourguignon (1981). According to this approach, savings rate is an increasing function of wealth and therefore inequality channelizes resources towards individuals whose marginal propensity to save is higher, increasing aggregate savings and capital accumulation and enhancing the process of development. The other approach, in contrast, answers a more crucial question: when does inequality matter? It argues that if there is a perfect credit market, even if there is inequality or some people have lesser wealth to start with, borrowing and lending activities would mitigate the problem of investment due to lack of initial wealth and thus eliminate the initial impact of inequality.

When the credit market is imperfect in the sense that it creates a wedge between the lending and borrowing rate then people with lower collateral become credit-constrained and the impact of initial inequality might get perpetuated.

1.1 Inequality and occupational choice: Role of credit constraint

Inequality under credit constraint plays deterministic role in occupational choices be it self-employment or human capital formation and thus has been at the center of a wide literature. Galor and Zeira (1993), for example, show that equality in sufficiently wealthy economies alleviates the adverse effect of credit constraints on investment in human capital and thus enhances economic growth. Banerjee and Newman (1993) took the first step to describe the interplay between wealth inequality and occupational pattern of an economy in an occupational choice model when capital market is imperfect and finally determine the long run path of the process of development. They provide an explanation as to why one country remains populated with small proprietors, artisans and peasants and another becomes a nation of entrepreneurs employing workers in large industries. In their model, when capital market is imperfect, people can borrow limited amount for investment. Poor people are thus credit-constrained and can not invest in occupations with high investment values. Thus rich people end up with the choice of that occupation which has the highest value of investment or entrepreneurship. There are four occupations: subsistence, working, self-employment and entrepreneurs. Only self-employment and entrepreneurship require investment of indivisible amounts. Because of capital market imperfection, a minimum wealth is required as collateral to borrow and invest as a self-employed, defined as w^*, and the minimum wealth required as collateral to borrow and invest as an entrepreneur is w^{**}. Therefore, for employment contracts to exist, some people must have wealth below w^* who would work for the entrepreneurs and some people must have wealth above w^{**}. If everyone is above w^* everyone is self-employed and if everyone is below w^* subsistence becomes the only option. Thus inequality is a necessity for the existence of employment contracts. In the dynamic

analysis too they find that the prosperity or stagnation crucially depends on the initial wealth distribution of an economy. If the initial distribution is such that the proportion of very poor to very rich is high enough, the economy ends up with low-employment and low-wage steady-state equilibrium while an economy with lower fraction of poor takes-off in the long run.

Various theoretical models of occupational choice have stressed the importance of incomplete information and borrowing constraints in the credit markets in generating a development process characterized with inequality and, in some cases, poverty traps (for example, Banerjee and Newman (1993); Piketty (1997); Aghion and Bolton (1997); Lloyd-Ellis and Bernhardt (2000); Ghatak and Jiang (2002); Giné and Townsend (2004)). Yuan and Zimmermann (2004) relate credit crunch that arises because of increasing loan risk with occupational choice of agents where entrepreneurs take loans for investment from bank and shows how banking regulations affect occupational choices. Colombo and Valentinyi (2002) emphasizes the relation between financial market imperfection and cross-country differences in income via occupational choice decisions. Hintermaier and Steinberger (2005) interpret occupational choice as a dynamic portfolio choice problem of a life-cycle investor facing a borrowing constraint. Antunes et al. (2008) study how financial frictions (intermediation costs and financial contract enforcement) affect economic development, occupational choice and inequality. Ahlin and Jiang (2008) examine the long-run effects of micro-credit on development in an occupational choice model similar to Banerjee and Newman (1993). They modify Banerjee and Newman (1993) model by adding a pure but limited improvement in the credit market and interestingly obtain an exception to the general rule that micro-credit lowers poverty in the long-run. In this perverse scenario, even though micro-credit initially raises income and reduces the number of subsisters, in the long run there are more subsisters, fewer entrepreneurs, lower aggregate income, and greater poverty.

A wide group of literature on human capital formation relates economic inequality, specially wealth/income inequality, and human capital formation (or educational investment). Most of the papers studying the effects of income inequality on economic growth through its effects on human capital accumulation have focused on the role of credit constraints. Empirical evidences have also been provided by Flug et al. (1998), Gregorio (1996) and Mejía (2003) in favor of the hypothesis that inequality and credit constraints affect investment in human capital. The main idea of this line of research is, relatively poor individuals don't have the means to finance the accumulation of human capital, and, because they are credit constrained, they end up either not investing in human capital or investing very little. In this respect, a closely related area of discussion centers on the question, whether inequality persists via investment in human capital. The theoretical idea has been extensively developed in the literature since the work by Becker (1975), Atkinson (1975), Loury (1981), Galor and Zeira (1993).

Loury (1981), Galor and Zeira (1993), Bénabou (1994) mainly focus on whether wealth distribution is ergodic or inequality is persistent in the long run using frameworks of human capital accumulation or educational investment. Loury (1981) shows, even under credit market imperfection (in fact, he takes an extreme form of imperfection that agents can not borrow from capital market) all initial wealth distributions in his model converge to a unique ergodic distribution. Galor and Zeira (1993) add a second assumption, that technology is non-convex, and show that the inherited distribution of wealth affects the economy not only in the short run but in the long run as well and dynamics are no longer ergodic. Bénabou (1994) shows that even minor differences in wealth, as well as minor imperfections in capital markets, can lead to a high degree of stratification and stratification makes inequality in education and income more persistent across generations. Further developments of the literature in this direction have

been proposed by Gregorio (1996), Bénabou (1996), Bénabou (2000) and many others. The motivation for the paper by Gregorio (1996) is whether a high savings rates, presumably caused by borrowing constraints, may translate in faster growth and they show that borrowing constraint results in a combination of physical and human capital leading to lower growth. Andergassen and Nardini (2007) present an overlapping generations model of human capital accumulation where educational investment involves indivisible investment and there is no option of borrowing and show that the equilibria in their model are characterized by a negative relationship between inequality and economic development.

There are theories that discuss the role of credit constraint on entrepreneurship, an alternative occupational choice. Karaivanov (2002) has shown how financial contract regimes differing in their degree of market incompleteness affect entrepreneurship when there is problem of moral hazard. The model depicts heterogeneous agents making occupational choice under three financial contract regimes: savings only, borrowing and lending, and insurance. He shows the fact that the relationship between wealth and occupational choice differs significantly under the various contract regimes. The main differences across the regimes in terms of the predicted probability of being entrepreneur as a function of wealth also occur for low levels of wealth: the savings only model predicts no entrepreneurship among poor agents as they cannot provide enough investment, while the other two regimes allow a positive probability of starting a business for such agents. Thus, economists unanimously agree that so long as indivisible costs are involved and there is lack of perfect capital market, inequality is an obstruction to occupational investment decisions.

1.2 Occupational investments and economic outcomes

So far we have given a brief review of the literature that explains how inequality affects various investment decisions and how the impact of inequality gets aggravated and might be perpetuated when borrowing constraint acts as a primary driving mechanism. This relates to a more crucial question: how this restricted investment decisions and occupational choices under capital market imperfection affect various economic outcomes? Quite a good number of theories in this strand of literature focus on the role of inequality while explaining the impact of occupational investments on the growth and development of an economy. While a huge literature centers on theories of inequality, human capital accumulation and growth a separate strand of the literature discusses the role of inequality in entrepreneurial investment and the long run wealth of an economy. Let us now discuss in brief.

1.2.1 Human capital formation

Galor and Moav (2004) develops a growth theory that captures the endogenous replacement of physical capital accumulation by human capital accumulation as a prime engine of growth along the process of development and argue that inequality neither stimulates nor obstructs the growth process consistently. They show that in early stages of the Industrial Revolution, when physical capital accumulation was the prime source of growth, inequality stimulated development by channeling resources towards individuals with a higher propensity to save. As human capital emerged as a growth engine, equality alleviated adverse effects of credit constraints on human capital accumulation, stimulating the growth process. Perotti (1996) and Easterly (2001) provide evidence in support of this link between equality, human capital and growth. Ghatak and Jiang (2002) examine whether history, in terms of initial wealth, affects the long run per-capita wealth of an economy. Their results are closely related to the contributions of Galor and Zeira (1993)

and Banerjee and Newman (1993). In fact, they consider a simplified version of the model of Banerjee and Newman (1993), in which, one needs no more information about the wealth distribution than the proportion of people whose wealth is below the level needed to start an enterprise. They derive the parametric condition under which initial condition matters in the determination of the long run wealth, both in the stochastic and non-stochastic environments. Banerjee and Newman (1993) also offer some simple examples to show instances of hysteresis. However, even in these examples, it is not always the case that the greater is the size of the poor relative to that of the rich in the initial distribution, the lower will be the steady-state level of income. Ghatak and Jiang (2002) obtain a relationship between initial inequality and the steady-state level of per-capita income of an economy when the initial condition matters.

1.2.2 Entrepreneurship

From Schumpeter (1911), entrepreneurs are believed to be a significant determinant of a country's economic performance, particularly with respect to innovation processes and job creation. Thus the determinants of entrepreneurship have caught attention of the researchers. In several discussions, economists have pointed out various factors that influence entrepreneurship of an economy. For example, Kihlstrom and Laffont (1979) obtained the relation between risk-aversion of individuals and entrepreneurship and have shown that the higher the risk-aversion of an individual is, the lower is the probability to become entrepreneur. But wealth has taken an indispensable role in this regard since entrepreneurial activity typically involves investment in capital. Wealth for investment can come from two basic sources: own wealth or borrowed funds. Liquidity constraints arising from credit market imperfections imply that the ability to borrow and hence the probability of becoming entrepreneur depends on agents' own wealth or increases with parental inheritance of wealth. This has been well recognized by several

researchers, for example, Evans and Jovanovic (1989), Holtz-Eakin et al. (1994a), Holtz-Eakin et al. (1994b), Dunn and Holtz-Eakin (2000), Paulson and Townsend (2002). Magnac and Robin (1996) replicate the empirical methodology of Evans and Jovanovic (1989) on French data and find that the effect of wealth on the probability of choosing self-employment (entrepreneurship) is significant and positive. Since wealth of an individual is important for his own entrepreneurial decision, from a macro perspective, wealth inequality must have deterministic impact on the entrepreneurship of an economy. Lindh and Ohlsson (1998) show that a more unequal distribution will imply more self-employed, since the number of people able to provide collateral will be higher. Swedish data between 1920 and 1992 suggest that wealth inequality and the share of self-employed among those working are positively related. The data, therefore, are consistent with the hypothesis that liquidity constraints are binding on the decision to become and stay self-employed. Banerjee and Newman (1993), as we discussed, also relate wealth inequality and occupational choice and emphasizes in their static framework the necessity of wealth inequality for employment contract between entrepreneurs and laborers to exist.

1.3 Plan of the thesis

As we have depicted, economists have taken variety of channels to argue whether inequality is harmful for an economy or is it, to some extent, a necessity for economic growth and development. When occupational investments involve indivisible costs and the credit market is not perfect people with low wealth become credit-constrained. Quite obviously the macro outcome depends upon the concentration of wealth among economic agents. Thus wealth distribution in turn determines the occupational pattern of the economy. While the role of wealth inequality on human capital accumulation and that on entrepreneurship have been separately discussed in economic literatures there is a huge

literature that depicts the effects of human capital accumulation on growth. The present thesis, in contrast, views the inequality-growth (and economic development) link from a more basic standpoint. It sheds light on how individual's wealth determines the investment decisions at micro level thereby simultaneously determining the occupational-mix (combination of both skilled workers and entrepreneurs) at the macro level, given the wealth distribution of the economy; and how this occupational pattern determines some economic outcomes of specific interest such as skilled-unskilled migration flows from the economy, outsourcing impacts of northern firms, gains and losses while opening up of the industrial sector to international trade. The thesis also provides some policy implications of the theories.

1.4 Summary of chapters and related literature

The basic results of the chapters in the thesis are summarized below.

Chapter 2

There are quite a number of papers on occupational choice but very few of them relate inequality and occupational choice to explain the process of economic development. As we discussed earlier, this strand of literature explains the persistence of poverty, borrowing constraint being a primary driving mechanism. Though 'entrepreneurship' and 'skilled laborer' as two separate occupations have been major areas of research only few papers are there on inequality and the occupational mix.

1.4.1 Inequality and occupational pattern

Banerjee and Newman (1993) took the first step to describe the interplay between wealth inequality and occupational pattern of an economy in an occupational choice model and

finally determine the long run path of the process of development. They provide an explanation to: why one country remains populated with small proprietors, artisans and peasants, another becomes a nation of entrepreneurs employing workers in large industries. The results of Ghatak and Jiang (2002) are closely related to the contributions of Galor and Zeira (1993) and Banerjee and Newman (1993). Loury (1981), Galor and Zeira (1993), Bénabou (1994) mainly focus on whether inequality is persistent in the long run using frameworks of human capital accumulation or educational investment. Empirical evidences have also been provided by Flug et al. (1998), Gregorio (1996) and Mejía (2003) in favor of the hypothesis that inequality and credit constraints affect investment in human capital. The main idea of this line of research is, relatively poor individuals don't have the means to finance the accumulation of human capital, and, because they are credit constrained, they end up either not investing in human capital or investing very little. Hence the distribution of wealth affects the aggregate amounts of investment in human capital and of output. In this respect, a closely related area of discussion centers around the question, whether inequality persists via investment in human capital. The theoretical idea has been extensively developed in the literature since the work by Becker (1975), Atkinson (1975), Loury (1981), Galor and Zeira (1993). In several discussions, economists have pointed out various factors that influence entrepreneurship of an economy. Since entrepreneurial investment typically involves wealth, wealth inequality is perceived to have significant impact on entrepreneurship of an economy. Karaivanov (2002) have shown how financial contract regimes differing in their degree of market incompleteness affect entrepreneurship when there is problem of moral hazard.

Chapter 2 of the thesis obtains a relationship between wealth distribution of an economy and its occupational mix - combination of entrepreneurs and skilled laborers. Wealth of an individual plays an important role for investment decisions, especially when there are indivisible costs that have to be incurred, be it an education cost for skill

formation or a set up cost for entrepreneurship. Again, if the capital market is imperfect, people can borrow only limited amount. As a result, investments of high value are beyond the reach of the poor. Each economic agent, depending upon his wealth level, makes that investment choice which gives him the highest net-return (return net of cost). Thus, for the entire economy, wealth distribution determines the number of individuals making similar investment patterns (or making similar occupational choice). Given that a high concentration of wealth among few implies high inequality in the wealth distribution, wealth inequality determines the number of individuals who are credit-constrained and are unable to make occupational investments involving credit. Chapter 2 assumes wealth to follow a standard distribution, Pareto distribution, the density function of which is such that the higher the value of the inequality parameter (that describes the inequality level), the higher is the concentration of people at the lower wealth level. In the model economy, one has to incur an indivisible set up cost to work as entrepreneur and an indivisible education cost, lower than the set up cost, to work as skilled laborer. This assumption is based on the studies which support and empirically justify that entrepreneurs are from the richer section of the wealth distribution (Evans and Jovanovic (1989); Hamilton (2000)). Thus, depending upon the initial wealth (or inheritance) each agent chooses that occupation which gives him the highest net-wealth (or utility). If the capital market is imperfect, poor people will be credit-constrained and decide not to invest in education or in the set up cost even by borrowing because the wealth after paying back the loan would be lower than what he would get remaining unskilled. Since wages and profits or the returns from the occupations are endogenous, the threshold wealth levels for both entrepreneurship as well as for educational investment are endogenous. Clearly, the incentive compatibility constraints for both the occupations get automatically satisfied; otherwise, nobody would invest in the occupation for which the return is not incentive compatible and its return would eventually rise in equilibrium to meet the constraint.

Thus, depending upon the wealth distribution the occupational pattern will be determined and whatever be the inequality level of an economy, employment contracts will *always* exist. This is in sharp contrast to Banerjee and Newman (1993) where the threshold wealth levels w^* for self-employment and w^{**} for entrepreneurship, do not depend on the wage or any endogenous variable of their model. Since the threshold values are exogenous, the 'scale' in the wealth distribution becomes so significant that in the static equilibrium the possibility exists that there is none to become entrepreneur or none to become working laborer. Both the cases imply non-existence of employment contracts. This in turn implies that a very poor economy, defined by all of its agents having wealth below w^*, would have no entrepreneur. The thesis in contrast shows that the occupational pattern will be determined by the *spread* rather than the *scale* of the distribution and emphasize that even a very poor economy would have entrepreneurs but its number will be determined by the inequality level or the 'spread' of the wealth distribution. Assuming rational expectation behavior of economic agents and taking Pareto distribution for wealth, it finds that the higher the inequality parameter the higher will be the number of skilled laborers employed by an entrepreneur in equilibrium. Given the fact that the market forces may not behave in a way that the private optimum matches with the social optimum, the chapter shows that for highly unequal economies the deviation between the private and the social optimum can not be corrected by an education subsidy, which is in sharp contrast to the usual belief. In case of an equal economy, however, it might be an appropriate policy to reach the social optimum when the private optimum deviates from the social optimum.

Chapter 3

Chapter 3 considers the issue of labor mobility from an economy. Since labor migration, especially of the skilled type, has a significant economic impact as it is often perceived to be a decay of skilled stock. The theory related to this provides highly controversial explanations. While the remittance issue and broadening of knowledge base of the migrated skilled laborer are the arguments in favor, the decay of skilled stock along with the associated national costs imputed in the accumulated skill of the migrated skilled laborer are the arguments against migration. Many other arguments are there as well. Prior to make suitable policy measures to encourage or to disincentivise labor migration, it is interesting to find the *type* of labor migration taking place given the characteristics of an economy. Chapter 3 attempts to link wealth inequality of an economy and the type (skilled, unskilled or both) of labor migration from an economy. There are many socio-economic reasons for labor migration from an economy. Let us briefly discuss the literature on the basic causes of migration.

1.4.2 Causes of migration: A brief review

Economic analysis of the migration decision began with Hicks (1932), who argued that differences in net economic advantages, chiefly in wages, are the main causes of migration. Sjaastad (1962) puts the migration decision in a human capital framework, arguing that a person will migrate if the present value of expected increased earnings exceeds the present value of investment costs. Almost all modern economic analyses of migration decisions follow this framework. In most models, the differential net present value of migrants' earnings in the receiving country and the country of origin is the key determinant and, with few exceptions, political factors have not been considered. Stark (1991) proposes an alternative theory that models migration decisions as family risk-spreading choices allocating their labor assets over different markets. Miyagiwa

(1991) and Wong and Yip (1999) introduce the phenomenon of brain drain explicitly in an endogenous growth framework where the wage gap between developed and developing countries induces migration and reduces growth through the formation of human capital. While conventional human capital models regard differential lifetime net earnings as the key motivation for emigration, Lam (2002) incorporates the interaction of economic and political factors into the emigration decision and the results show that lack of political confidence increases the emigration propensity significantly. In contrast to the neoclassical growth model that states, with perfect capital mobility migration is impossible or at least a transitory phenomenon, Reichlin and Rustichini (1998) show that in all equilibrium paths the migration flow does not vanish over time. Assuming increasing returns and perfect capital mobility, their paper state that the driving forces behind labor migration are the size and the composition of the workforce. Among the factors that have been shown to affect incentives to migrate significantly within various empirical frameworks, are financial returns such as relative income and inequality (for example, Borjas (1987); Helliwell (1997); Hatton and Williamson (2002)). Network effects have also been subject to special scrutiny in the migration context as they are seen as alleviating migration costs (Bartel (1989); Zimmermann (1996)) or improving employment and/or wage opportunities for newcomers (Gross and Schmitt (2003)). Gross and Schmitt (2006) investigate empirically whether standard determinants influence international migration of workers to France with the same intensity across different skill levels and with or without free mobility. He finds that low-skill migrants respond to most push and pull migration factors. High-skill migrants however respond only to financial incentives and cultural clustering does not matter. Schmitt and Soubeyran (2006) provide an interesting 'basis of migration' in an occupational choice model. They analyze the allocation of two types of individuals differentiated by talent between two countries where they choose to be workers or entrepreneurs and show that an equilibrium with

international migration exists when countries' talent endowments are sufficiently different. An interesting result in their model is that individuals might switch occupations hence the industry structure might change by the migration of the talented individuals.

1.4.3 Inequality and migration incentives

The wage gap (or the differences of income opportunities) of the source and the host economy is depicted to be the prime force behind migration. It is somewhat surprising that inequality as a determinant of the incentives as well as the nature of international labor migration has so far not been explored intensively. There are few papers relating wealth distribution and migration incentives. The Roy (1951) model offers a rigorous and theoretically powerful framework to analyse the self-selection of migrants. According to the Roy (1951) model, self-selection is driven by comparative advantage of individuals which has important policy consequences. Since rich countries have a higher equality in the distribution of earnings than poor countries on an average, the Roy (1951) model predicts that migrants from poor countries are unfavourably selected with regard to their skill levels and other abilities relevant for their labour market performance. This negative selection bias may increase overtime, since more and more migrants come from poor economies. Borjas (1987) in his 'self-selection theory', which applies the classical Roy (1951) model to the migration context, has analyzed the relation between the income distribution and the skills of migrants. A key and much-disputed prediction of Borjas (1987) is that if the host country has less income inequality than the source country and if the correlations between the incomes of the migrants (potential) in both the locations is positive, the emigrants will be chosen from the lower tail of the income distribution of the source country, *i.e.*, migrants from countries with more inequality will tend to be negatively self-selected. In the other case, the emigrants will be chosen from the upper

tail of the income distribution of the source country and these immigrants will outperform the native born. However, this is obtained assuming that all migration costs are proportional to wages at home and therefore do not determine self-selection patterns. In practice, international migration is costly and involves monetary costs which can prevent migration of credit-constrained people. The models of self-selection processes by Chiswick (1999) and Chiquiar and Hanson (2005) predict that positive self-selection will occur even in countries with high inequality if migration costs are lower for the highly-skilled, although positive self-selection may be weakened. Again, skilled migrants have better host-country language skills, which lowers the costs of adjustment and integration hence this may possibly reverse any tendency towards negative self-selection arising from higher inequality at origin. Liebig and Sousa-Poza (2004) support these alternative models and find that a higher income inequality tends to foster emigration. The impact of income inequality on the inclination to migrate, however, becomes insignificant in the highly-skilled sub-sample. Importantly, however, there is no indication of a negative relationship, as predicted by Borjas (1987). Even when income inequality in the country of origin is high, positive self-selection can still be expected. Stark (2006) provides an analytical-behavioral explanation for the observed positive relationship between income inequality (measured by Gini coefficient) and the incentive to migrate by a theory of total relative deprivation (positively related to the Gini coefficient) of a population that leads to a stronger incentive to engage in migration. Migration incentives within a country, for example rural urban or inter-state migration, have also been studied extensively in the literature. However, the basic causes are not too different from inter-country migration incentives. In this respect the 'economic segmentation theory' rejects the general assumption of the economic opportunity thesis that rural-urban migration is caused primarily by higher paying jobs in the urban sectors or in the destinations. Depending upon the fact that differential regional development in a peripheral (less developed) nation affects the income structures, Fukurai et al. (1987) state in an empirical study

of the inter-regional labor movements in Mexico that inter-state migration is the result of regional income inequality. The analysis shows that the level of income inequality in both sending and receiving states significantly affects inter-state migration thus points to the importance of examining structural factors at inter-state migrants' origin rather than only those at destination.

Many economists recognize the inequality-migration link via the role of financial constraints for migration decisions. For example, Greenwood (1993) shows that migration appears to be a function of the assets that a household has to cover the cost of moving. Lack of assets may impede mobility. Chiswick (1999) shares the same point of view that migration occurs if the rate of return from the investment in migration is greater than or equal to the interest cost of funds for investment in human capital. The interest costs of funds is lower, the greater the person's wealth and access to the capital market. Assuncao and Carvalho (2005) show how wealth plays deterministic role in migration decisions and state that: "*The nature of the impact of financial constraints on education and migration is twofold. First, they might be positively correlated because rich individuals can afford both education and migration costs. Poor people, on the other hand, remain in the home country with low levels of education. Second, there is a potential negative correlation between migration and education because these choices are traded off in the budget constraint.*" Thus, by this argument, they explain an interesting question: why are most emigrants leaving some developing countries from middle-class? They show that this phenomenon might happen when the migration premium, difference between the wages of a worker with zero years of schooling in the two countries discounted by the cost of migration - and return to education in the source country are both high. Then the rich people obtain high levels of education and stay in their country - the income generated from the accumulation of human capital surpasses the migration premium for them. Poor also remain at home because they cannot afford migration costs.

Middle-class individuals, on the other hand, decide to migrate, since they cannot get enough education to compensate for the migration premium. However, Banerjee and Kanbur (1981) were the first to show that middle-class is the most mobile one in some situations. Khwaja (2002) presents a model where inter-linkage between credit and labor can be the efficient contract, when the destination wage is not verifiable by the lender and when the migrant household has insufficient funds to be used as collateral. The paper considers an interlinked contract where the borrower may be required to supply labor at a discounted rate as part of the repayment. Now, poor households can borrow from the relatively wealthy landlords in order to finance their migration decision. In villages where everybody is poor there is no possibility of an interlinked contract hence no possibility of migration. Given the unverifiability of the destination wage, only those households with sufficient collateralizable assets can afford to borrow from moneylenders to finance their migration decision. This could explain the apparent paradox of why poor households in villages where asset distribution is very skewed are more likely to migrate than households in poorer villages with less unequal asset distribution. Hence, the very presence of inequality is a necessary condition for migration to take place.

Chapter 3, in contrast to the literature, focuses the opportunity cost or the foregone wealth of migration rather than the wage-gap as the prime driving force of an agent's migration decision while relating wealth inequality and migration incentives of skilled and unskilled laborers in a model of occupational choice. When there is a cost of migration and credit market is imperfect low-wealth people are credit-constrained. Thus occupational choice decisions as well as migration decisions at the micro-level depend upon individual's wealth level and hence the wealth distribution of the economy determines the occupational mix along with the returns to occupations. Therefore, given the external wage, the migration decision depends upon the opportunity cost or the returns from the alternative occupations as well. When the wealth distribution is highly

skewed such that few people are there at the higher wealth end to invest as entrepreneurs then the returns to entrepreneurship, an alternative occupation to skilled migration, is high which creates a disincentive to migration. Thus Chapter 3 provides a theoretical explanation to support the empirical observation that the relative migration of skilled (unskilled) labor tends to occur from developing economies that are relatively equal (unequal). Though Chapter 3 agrees with Assuncao and Carvalho (2005) that *if at all* there is skilled migration from an economy, the rich will not take the migration decision, relatively poor will migrate while the rich people become entrepreneurs, it shows the bleak skilled migration possibility from highly unequal economies as an additional outcome. In case of unskilled labor migration, Chapter 3 argues in similar line with Khwaja (2002) who shows, poor households in villages where asset distribution is very skewed are more likely to migrate than households in poorer villages with less unequal asset distribution. However, Chapter 3 considers skilled migration as well in contrast to Khwaja (2002).

Chapter 4

Chapter 4 of the thesis is a bit digression from the earlier two chapters. It discusses about wage inequality and provides a new explanation to the recent skilled-unskilled wage gap rising phenomenon in both North and South by an occupational choice model. The literature starts from casual as well as rigorous empirical investigations that reveal, in the recent phase of globalization the general trend has been an increase in the ratio of skilled to unskilled wages or a widening wage-gap between skilled and unskilled workers in most part of the globe (Wood (1997)), except for a few East Asian countries. This rise in wage inequality has been a great concern for economists, more so, since the wage incomes moved against the unskilled workers, who constitute the vast majority of the population living below or around the poverty line. While, for the developed countries, who export mostly skilled intensive commodities, simple trade theory

(Stolper-Samuelson-Theorem) can explain such a rise in wage inequality as an impact of opening up of economies but such theories contradict the rise in wage inequality in the developing countries that primarily export unskilled labor intensive commodities. Though economists have provided varieties of reasons, the recent observation has widely been attributed to either trade or technological change mainly because of its empirical validity.

Following the literature the basis for such an observation relates mainly to: (1) technology bias towards skilled labor (Bound and Johnson (1992); Lawrence and Slaughter (1993); Krugman (2000)), (2) increased openness/trade (Leamer (1993); Leamer (1995); Leamer (2000); Borjas and Ramey (1995); Robbins (1995); Feenstra and Hanson (1996); Wood (1997)). Whereas the technological change may have a more dominant influence on the wage inequality in the advanced industrialized countries, there are quite a handful of evidences that indicate a dominant role of trade in the developing countries (Marjit and Acharyya (2002)). For example, the association between trade liberalization and widening wage-gap in Latin America has been observed by Feenstra and Hanson (1996), Robbins (1995) and Wood (1997). Increased trade in the phase of globalization is explained either by reduced costs of trading due to easier access to the inputs of production in different parts of the integrated world, spreading of trading activities across the globe depending upon the costs of production or due to a tariff cut or other policy induced reductions of trade obstructions. For example, Beaulieu et al. (2004) argue that a reduction in trade barrier in hi-tech sectors might lead to such a rise in wage gap in both developed and developing countries. Zeira (2007) shows that trade liberalization increases the wage gap in developed countries, but reduces it in less developed countries. Since in recent decades an increase in the wage gap in less developed countries is also observed, he concludes that it cannot be the result of trade liberalization only and one needs to add the effect of skill-biased technical progress, which according to

his model increases the wage gap both in developed and in less developed countries. Thus he emphasizes that the widening of the wage gap between skilled and unskilled workers cannot be attributed to any one factor, neither to trade liberalization nor to skill-biased technical progress. In fact, he shows the role of trade liberalization has been rather small. The changes in both the technology and trade, however, are exogenous in his explanation. Thoenig and Verdier (2003) also show in a North-South trade model that both trade liberalization and technological changes affect wage gap but in a totally different aspect. When globalization triggers an increased threat of technological imitation (or leapfrogging), firms tend to respond to that threat by biasing the direction of their innovations toward skilled labor intensive technologies. This causes a process of defensive increase in wage inequalities in both regions.

When the economies are globally integrated the easier access to the cheaper factors of production across the globe hence the possibility of spreading the economic activities, broadly defined as 'outsourcing', can well explain the trade expansions and thus have caught the attention of the researchers trying to explain the wage gap rising phenomenon.

1.4.4 Outsourcing and rise in wage inequality

Feenstra and Hanson (1999) attribute 15% of the rise in wage gap in US to outsourcing by US MNFs. Hijzen (2007) analyzes the impact of international outsourcing on UK wage inequality during 1990s by applying the mandated wage approach proposed by Feenstra and Hanson (1999). The paper finds that technological change is the predominant force behind the rising wage gap but international outsourcing also played significant role. Feenstra and Hanson (1997) show that growth in FDI is positively correlated with a rise in relative demand of skilled labor, which is consistent with the hypothesis that outsourcing by the multinationals has been a significant factor in the rise in demand for

skilled labor in Mexico. In another paper by Feenstra and Hanson (1995) a factor endowment model has been presented where one good is produced by continuum of goods ranked with skill intensity. North outsources relatively unskilled intensive products to South, where these are relatively skilled intensive. Thus an inflow of northern capital in South causes a rise in the relative demand for skilled labor in both the countries. Their paper could explain the fall in the relative demand for unskilled labor hence the relative fall in unskilled wage in US during 1980s. Gao (2002) presents a two-country model where outsourcing and skilled-unskilled wage are endogenously determined and shows that globalization, in terms of reduction in trade costs, leads to a rise in both outsourcing and skilled-unskilled wage in both the countries. Canals (2006) finds that between 1980 and 1999, outsourcing accounts for 28% of the observed wage change, and biased technological change for another 18%. Jointly these two forces explain 58% of the wage change. These suggest that both globalization and technological change were important determinants of the relative decline in wages for unskilled workers in the US and the observed divergence in the skilled wage premium. Shifts in outsourcing are defined as changes in the demand for imported intermediates inputs as a result of technological improvements (after controlling for factor price changes), which can be understood as an outsourcing biased technological change. They refer to biased technological change as those technological improvements affecting the relative quantity of labor and capital needed to produce one unit of final good. Finally, total technological changes are all the previous changes considered at the same time. This study is in contrast to the one by Feenstra and Hanson (1999) that use a partial equilibrium model with exogenous shocks to outsourcing to explain the effects on the wage gap. Sayek and Sener (2001) investigate the issue of FDI and wage inequality, using a dynamic North-South model that incorporates the mechanics of technological progress and outsourcing and show that when increased FDI is driven by technological change, the impact on the wage differential between skilled and unskilled labor in the North and the South is ambiguous.

Whereas if FDI is driven by policy changes such as production subsidies by the South or production taxes by the North, the wage gap in both economies widens.

In contrast to the literature that explains the phenomenon either by trade or by technological improvement, Chapter 4 shows that it is neither technology nor trade alone but *both* that have contributed to the widening wage inequality. Using a two-country occupational choice model it argues, any technological improvement in North results in a rise in the skilled-unskilled wage gap in North via an increase in the productivity of the skilled laborer followed by a rise in the same in South via trade or outsourcing activities of the northern firms. Chapter 4 also analyzes some major economic impacts of such a technological upgradation in North on the southern economy.

Chapter 5

Chapter 5 relates wealth inequality and industrialization. It shows that in a two-good economy with a basic good and an industrial/luxury good when trade is opened up in the industrial good sector, depending upon the inequality level of the economy the sector might cease to exist. This is because of insufficient incentive to entrepreneurship under free trade via a low external price of the industrial good. The industrial good would then be imported and rich people being the sole consumers of industrial good would enjoy the benefits of globalization via a lower price. Here inequality-industrialization under free trade works from supply-side by a production externality similar to the 'learning-by-doing' technology of Matsuyama (2002). The relation between inequality and industrialization has been discussed from the demand-side in a wide literature. Let us provide a brief review.

1.4.5 Inequality and industrialization

The inequality and demand-constraint is often believed to be a significant channel through which inequality affects the process of industrialization. Earlier theories of Lewis (1954), Ranis and Fei (1961) mainly highlight the role of farm sector in creating adequate demand or purchasing power in the industrial sector and boost industrialization. Murphy et al. (1989) provide a demand-side story that poses the problem in a more interesting way. They state that, the vibrancy of domestic agriculture is not that always helps industrialization. In some cases, though the farm sector generates adequate income it does not go to the potential consumers of the relevant industries and the market remains narrow. They argue that "*For industrial markets to expand, the composition of demand must concentrate buying power in the hands of consumers of manufactures*". In their model, people having a preference for diversity of goods they consume, the richer the person the larger is the commodity basket consumed by him. They depict industrialization as production of a good in the increasing returns sector with a fixed set up cost rather than in the back stop technology sector under constant returns. Murphy et al. (1989) conclude that inequality is an obstruction to the process of industrialization because it restricts the size of the market. For increasing number of industries to break-even sales must be large enough to cover the set up cost. Now, higher the inequality, *i.e.*, the lower the number of rich or the smaller the middle class, the lower is the number of goods produced in the modern sector or the lower is the extent of industrialization. They show that both too much equality as well as too much inequality obstruct industrialization. In the former, in a poor country the income of each consumer may fall short of the minimum income needed to go for the manufactured consumption. In case of too much inequality when too few people have high income to consume the manufactured good, the demand is too low to cover the fixed cost needed in the industrial sector. Thus, the necessity of a middle class in the central message of their model. A similar conclusion has been reached by Sarkar (1998) in a dynamic

framework that the size of the middle class is significant in the determination of the rate of growth. In Sarkar (1998) technological progress and endogenous growth is viewed from demand-side. Here there are two goods one homogeneous and the other one is differentiated with high and low quality levels. The profit earners or the rich consume the high quality differentiated good and the middle class consume the low quality good. The poor consume only the homogeneous good. Technological progress occurs in the differentiated good. Technological progress in the high quality good depends on the profit generated in that sector hence on the expenditure on that good. Since the high quality good is consumed by the profit earners (rich), technological progress in that good therefore depends on the profit generated outside that sector. The homogeneous good is assumed to be perfectly competitive hence the size of the middle class who consume the low quality good is significant for technological progress hence for growth of the economy.

Matsuyama (2002) presents another demand-side framework that links inequality and industrialization. His model depicts the development process as a series of industries taking off one after another. As productivity improves in these industries, each consumer good becomes affordable to an increasingly large number of households, which constantly expand the range of goods they consume. This in turn generates larger markets for consumer goods and leads to further improvement in productivity. In order for such two-way causality to generate virtuous cycles of productivity gains and expanding markets, income distribution should be neither too equal nor too unequal. Some income inequality is needed for the economy to take off; too much equality means that the economy stagnates in a poverty trap. With too much inequality, the economy's development stops prematurely.

Foellmi and Zweimüller (2006) introduce non-homothetic preferences into an innovation based growth model. High concentration of wealth (inequality) may foster innovation and growth by creating a wealthy class willing to pay high prices for new products but may hinder innovation by preserving a poor majority which could otherwise form mass markets. They show, price effects dominate market-size effects and a redistribution from the poor to the rich may be Pareto-improving for low levels of inequality. In contrast to Matsuyama (2002), industrial R&D drives growth in their model, and income distribution affects growth due to its impact on innovation incentives. While there is no scope for new firms to set prices in Murphy et al. (1989) so any effect of income distribution is transmitted via its effect on market size, the model of Foellmi and Zweimüller (2006) goes beyond these studies in focusing on the double role of inequality both on the innovators' prices and on the evolution of the innovators' markets.

Chapter 5, in contrast, links inequality and industrialization from supply-side. Here, by the supply-side externality, the more the number of entrepreneurs is the higher is the productivity of the industrial sector. This is also similar to the type of externality assumption of Paternostro (1997) that the fixed cost faced by each monopolist is a decreasing function of the number of firms that industrialize, thus resembling the type of externalities conceptualized as learning-by-doing in the process of entry. With an indivisible set up cost for entrepreneurship and an imperfect credit market poor people are credit-constrained. The higher the inequality of an economy is the lower is the concentration of people at the higher wealth end of the wealth distribution. Thus number of credit-constrained people for entrepreneurship is higher implying a lower number of entrepreneurs. Since domestic demand doesn't play much role when trade is opened up this lower supply-side externality leads to lower equilibrium profit (incentive to entrepreneurship) and non-existence of the industrial sector at the extreme. Chapter 5 suggests that opening up of trade might obstruct industrialization for highly unequal economies but

opening up along with suitable policy measures might be Pareto-improving. Thus it emphasizes that the crucial question is not 'whether to globalize' but 'how to globalize' and provides some interesting policy suggestions that can make globalization more inclusive. Chapter 5 also shows that under restricted trade, the policy of subsidizing entrepreneurs when poor are credit-constrained to invest as entrepreneurs might not be effective in the sense that it does not improve the utility of the new group of entrepreneurs.

1.5 Conclusion

The thesis relates wealth inequality of an economy and various economic outcomes under capital market imperfection. It sheds light on how individual's wealth determines the investment decisions at micro level thereby simultaneously determining the occupational-mix (combination of both skilled workers and entrepreneurs) at the macro level, given the wealth distribution of the economy; and how this occupational pattern determines some economic outcomes of specific interest such as skilled-unskilled migration flows from the economy, outsourcing impacts of northern firms, gains and losses while opening up of the industrial sector to international trade. Occupational investments typically involve indivisible costs and when the credit market is not perfect people with low wealth become credit-constrained. Thus the concentration of wealth among economic agents in turn determines the occupational pattern of the economy and the macro outcomes as well. The occupational-mix is tilted towards skilled laborers for unequal economies when educational investment is the less costly occupational investment than entrepreneurship. Considering the mobility of laborers across economies with an indivisible cost of migration, the low-wealth people become credit-constrained when the credit market is imperfect. When the wealth distribution is highly skewed such that few people are there at the higher wealth end to invest as entrepreneurs then the returns to entrepreneurship, an alternative occupation to skilled migration, would be high which

is a disincentive to migration. This provides a theoretical explanation in support of the empirical observation that the relative migration of skilled (unskilled) laborer tends to occur from developing economies that are relatively equal (unequal). In other words, inequality is an obstruction to skilled labor migration while an incentive for unskilled labor migration. Again, considering the process of industrialization under globalization the thesis reaches the conclusion that inequality is indeed an obstruction to industrialization. The thesis also analyses the effectiveness of some policy measures and suggests suitable policies for an unequal economy.

Chapter 2

Wealth Distribution and Occupational Pattern

Introduction

Casual empiricism shows that some countries are endowed with many entrepreneurs but relatively small group of skilled workers whereas some other countries possess few entrepreneurs but a large number of skilled working population. Occupational pattern is an important determinant of the mode of industrial activities of an economy and both the entrepreneur and skilled worker are essential for production. The question that arises is why do countries differ in occupational pattern? Now, occupational investments typically involve wealth. Therefore, the distribution of wealth must have some influence on the occupational distribution of an economy. The present chapter attempts to provide a link between the wealth distribution of an economy and its occupational pattern with special emphasis on the role of 'wealth inequality'. Since, it has been observed that the distribution of wealth varies significantly among countries; the chapter shows how such differences in wealth inequality can explain the differences in occupational patterns across economies.

A simple model of occupational choice has been presented in this chapter. In an economy, if there is an indivisible education cost that has to be incurred to work as

skilled laborer and there is a fixed set up cost, higher than the education cost,[1] for becoming entrepreneur, poor people will be credit constrained to invest in education or in the set up cost if credit market is imperfect. With the assumption of an imperfect capital market,[2] the chapter shows that, if wealth follows a very standard distribution, Pareto distribution, the countries with high (low) inequality will have a skilled -entrepreneur ratio biased towards the skilled (entrepreneurs). Higher inequality in Pareto distribution implies that a larger concentration of people at the lower wealth range.

Interestingly, the threshold wealth levels for several occupational investments in the model, unskilled workers, skilled workers and entrepreneurs, are all endogenous. This is in contrast to most of the models of occupational choice in the literature. Thus, in this framework, what becomes important is the *'spread'* rather than *'scale'* of wealth distribution for the determination of occupational pattern and that is why even a poor economy with very low levels of wealth of its agents would sustain with all the occupations. This is because of the fact that when any of the occupations does not exist, the returns to that occupation would become large by the endogeneity of the occupational returns. Thus, in equilibrium all the occupations would be restored.

Occupational choice models have been used in several papers, for example, Banerjee and Newman (1993), Fender (2005), Ghatak and Jiang (2002), Chakraborty and Citanna (2005), Mukherjee and Ray (2005), Iyigun and Owen (1998), Laussel and Breton (1995) but in different contexts, and very few of these papers link wealth inequality of

[1]There are papers that support and empirically justify that entrepreneurs are from the richer section of the wealth distribution. Evans and Jovanovic (1989) were among the first to find the determinants of entrepreneurship focusing in particular the effects of receiving large bequests on the probability of becoming entrepreneurs. Subsequent studies (for example, Hamilton (2000)) also find similar effects of large positive income shocks on entrepreneurship.

[2]The assumption of capital market imperfection is very common in the literature of economic development. See for example, Galor and Zeira (1993), Banerjee and Newman (1993).

an economy as a major determinant of its occupational pattern. The present framework differs from that of Banerjee and Newman (1993) since the wealth thresholds for occupational investments are endogenous here. This implies, even a very poor economy would survive with several employment contracts. But this is not the case in Banerjee and Newman (1993).

The chapter also analyzes the welfare of an economy along with some policy implications. In the private utility maximization exercise, each individual in the model maximizes his/her own utility which does not include the utility of other individuals. However, the central planner might be interested to maximize the social welfare which is the total output of the economy excluding the net payments to the foreigners that goes out of the economy in the form of repayment of loans, taken by all the economic agents from the capital market to make their occupational investments. The private optimum skilled labor-entrepreneurial ratio may not exactly match with the social optimum. If the private optimum of an economy is lower than the social optimum then any policy that reduces the education cost (for example, education subsidy) or increases the set up cost, would raise the private optimum and help to reach the social optimum. The chapter shows that for highly unequal economies the private optimum value of skilled labor-entrepreneur ratio is so high that the social optimum can never be higher than that. Thus, an education subsidy is *not* an appropriate policy for such economies. However, for highly equal economies the private optimum being too low, education subsidy might be an optimal policy to reach the social optimum by raising the private optimum.

Developing economies often adopt education subsidy as means of creating 'equality of opportunity' in addition to boost the process of human capital accumulation and hence growth. Economists provide both the reasons in favor of and against the provision of education subsidy. The underlying justifications for education subsidy take varieties of

forms but mostly the arguments concentrate on perceived positive spill over effects of human capital accumulation in production (Lucas (1988); Tamura (1991); Stark and Wang (2002)). As these externalities are not taken into account in individual schooling decisions, education subsidies are needed to prevent under-investment in education and to promote economic growth. The other one is distributional concerns or on capital market imperfections and borrow against human capital issues since it may hinder poor individuals to finance educational expenditures and cost of living while at school (Saint-Paul and Verdier (1993); Perotti (1993); Bénabou (2000); Bénabou (2002); Hanushek et al. (2003); Bovenberg and Jacobs (2005)) and thus based on 'equality of opportunity'. There are other line of arguments as well. When there are complementarities in educational decisions by agents and technology adoption decisions of entrepreneurs, educational subsidy might be helpful in reaching the high-technology equilibrium (Chander and Thangavelu (2004)). Taking endogenous educational technologies, hence endogenous educational cost, Rigolini (2004) shows that an educational subsidy leads to efficient competitive equilibria. Considering a two-way causality between skill formation and foreign direct investment, Hoffman (2003) shows that if a threshold level of skilled stock is achieved by means of subsidy, FDI comes in, which in turn pushes up demand for skilled and magnify the effect of subsidy. These discussions in favor of education subsidy, however, do not consider entrepreneurship.

There are strong arguments as well against the provision of education subsidy. For example, in a general equilibrium model where there is a product sector, an education sector and government employs educated laborers for public goods provision and for political economy reasons, Upadhyay (1997) shows that education subsidy may cause fewer public goods and retard the product sector. Caucutt and Kumar (2003) develop a simple dynamic general equilibrium framework to address the effects of increasing higher education subsidies in the US, from their already substantial levels, on inequality, welfare,

and efficiency. They conclude that the case for increases in higher education subsidies might have been overstated. Rojas (2004) uses an overlapping generations model with endogenous fertility choices to analyze the quantitative costs and benefits of subsidizing higher education. The paper investigates the interaction between a policy aimed at subsidizing higher education and the sustainability of the social security system paying particular attention to the demographic change as the critical mechanism that relates both policies. It is found that an increase in education subsidies changes the educational composition of the population and lowers average fertility. Lower average fertility and higher life expectancy of educated individuals translates into changes in the age structure of the population that requires an increase in the social security tax rate in order to balance the pension budget. Such process reduces the welfare benefits of this educational policy since the rise in social security taxes lowers the after-tax lifetime earnings of almost all individuals born in the period of the policy reform and over. Kaganovich and Zilcha (1999) also considers a model of government's allocation of tax revenues between two outlays: public investment in education (a transfer to the young generation) and social security benefits to the older generation and shows that educational subsidies does not necessarily increase the growth rate. Sahin (2004) uses a game-theoretic model to analyze the disincentive effects of low-tuition policies on student effort and shows that although subsidizing tuition increases enrolment rates, it reduces student effort. This follows from the fact that a high-subsidy, low-tuition policy causes an increase in the percentage of less able and less motivated college graduates. Additionally and potentially more important, all students, even the more highly motivated ones, respond to lower tuition levels by decreasing their effort levels. Thus the high-subsidy, low-tuition policies have both disincentive effects on students' study time and adverse affects on human capital accumulation. Andersen (2005) shows that in the phase of globalization, countries are concerned with preserving skilled stock and the policies that balance government's budget and keep skill formation and migration incentives unchanged. He shows that a

combination of lower taxation of skilled workers and reduced educational subsidies will maintain educational incentives without leading to more emigration when mobility costs become lower because of global integration. Hendel et al. (2005) provide an interesting argument. They show that when education acts as a signal and borrowing for education is difficult, lack of a college education could mean that one is either of low ability or of high ability but with low financial resources. Unskilled workers are paid according to the expected quality of uneducated labor force; hence making education more affordable implies some of the high ability people come out of unskilled labor force driving down the unskilled wage. Thus education subsidy increases wage-inequality. However, none of the above papers provide the link between inequality and occupational choice and thus can not relate the necessity of education subsidy with the inequality level of an economy.

The chapter is organized as follows. In Section 2.1 of the chapter the basic model is presented, Section 2.2 shows the welfare of an economy with some policy implications. The dynamics is depicted and a calibration of the model is done to find the long run convergence of wealth in Section 2.3. Section 2.4 provides the concluding remarks. The Appendix in Section 2.5 contains derivations of few results given in the main text.

2.1 The basic model

The model utilizes a two-period overlapping generations (OLG) framework. There are infinitely many altruistic people with population normalized to unity. It is a small open economy with international capital mobility, facing a given rate of interest from abroad. The credit market is imperfect with a gap between the lending and borrowing rates. There is only one good. It can be produced in two sectors: one with only unskilled laborer (home production type) and the other in which entrepreneurs employ skilled workers. Full employment prevails in both the labor markets.

Each agent's choice with respect to occupational investment and employment is as follows. In the first period of his life, each individual receives inheritance and decides over occupational choice. If he decides neither to take education nor to become entrepreneur, he invests the wealth in capital market and works as unskilled in the first period. Otherwise, he may choose to invest in education to work as skilled laborer; or he may choose to invest in the set up cost and become an entrepreneur.

To make any of the above investment decisions, he may borrow from capital market if he does not have adequate wealth. In case he has adequate wealth, he makes the desired investment and lends the rest of inheritance in capital market.

In the second period of his life, each individual earns according to the investment made in first period (unskilled people continue to work as unskilled laborers in the second period), consume, and leave a bequest.

Production technology

The home production sector uses unskilled laborers and produces under linear technology, $Y = wL$ where L denotes unskilled laborer and w is unskilled wage. The good can also be produced by each entrepreneur, j, with skilled laborers by the following production function:

$$Y_j = AH_j^{\alpha}K_j^{\beta}; \quad A > 1, 0 < \alpha + \beta < 1$$

where A is technology parameter, H_j is the skilled laborers employed by each entrepreneur j and K_j is the capital used by each entrepreneur j.

Diminishing returns to scale implies the presence of some fixed factor, which can be interpreted as fixed entrepreneurial effort. Notice the distinguishing feature of this two-sector model that unskilled and skilled laborers are not directly substitutable in production, while skilled labor and entrepreneurial efforts are.

Suppose, v is the skilled wage and r is the internationally given rate of interest. Then the profit of each entrepreneur is

$$\pi_j = (Y_j - H_j v - K_j r)$$

Each entrepreneur maximizes profit and decides the capital to be deployed and the skilled labor employment according as:

$$\begin{aligned} r &= A\beta K_j^{\beta-1} H_j^{\alpha} \\ v &= c_1 \alpha H_j^{\frac{\alpha+\beta-1}{1-\beta}} \end{aligned} \tag{2.1.1}$$

where $c_1 = \left(\frac{A^{\frac{1}{1-\beta}} \beta^{\frac{\beta}{1-\beta}}}{r^{\frac{\beta}{1-\beta}}} \right)$.

Assuming that all entrepreneurs are identical in their profit maximizing behavior an entrepreneur's profit is as follows.

$$\pi_j = c_1\{1-(\alpha+\beta)\} H_j^{\frac{\alpha}{1-\beta}} = \pi \quad \forall j \tag{2.1.2}$$

Eqs. (2.1.1) and (2.1.2) respectively define

$$v = v(H_j); \quad \pi = \pi(H_j) \tag{2.1.3}$$

Once H_j is determined (endogenously), (2.1.3) yields equilibrium v and π.

Preferences and occupational choice

The utility function is defined over consumption 'c' and the bequest 'b': $U = c^{\delta}b^{1-\delta}$, where $0 < \delta < 1$. In period 2, this is maximized subject to, $b + c \leq Z$, where Z denotes net-wealth in period 2. Z equals:

$$\begin{aligned}
&(x+w)(1+r)+w; && \text{if he decides to remain unskilled} && \text{(i)}\\
&(x-h)(1+i)+v; && \text{if he invests in education and is a borrower} && \text{(ii)}\\
&(x-h)(1+r)+v; && \text{if he invests in education and is a lender} && \text{(iii)}\\
&(x-g)(1+i)+\pi; && \text{if he invests in set up cost and is borrower} && \text{(iv)}\\
&(x-g)(1+r)+\pi; && \text{if he invests in set up cost and is lender} && \text{(v)}
\end{aligned}$$

Here x is the inheritance, h is indivisible education cost and g is indivisible set up cost of entrepreneurs. We assume $g > h$.[3] From the capital market imperfection assumption, $i > r$, where i is the borrowing rate and the lender enjoys r.[4]

As the indirect utility function is increasing in Z, in period 1, the objective is to maximize Z, or net-wealth. A person decides to invest in education if his net-wealth by investing in education does not fall short of that he would receive if he remains unskilled. Let s denote the threshold inheritance above which a person decides to invest in education. By comparing (i) and (ii) we get s for $x < h$ as

$$s = \frac{w(2+r) + h(1+i) - v}{i - r} \tag{2.1.4}$$

In view of the function $v(H_j)$, s is a function of H_j, $s(H_j)$. We have $s' > 0$ as $v'(H_j) < 0$.

[3]There are papers that support and empirically justify that entrepreneurs are from the richer section of the wealth distribution. Evans and Jovanovic (Evans and Jovanovic (1989)) were among the first to find the determinants of entrepreneurship focusing in particular the effects of receiving large bequests on the probability of becoming entrepreneurs. Subsequent studies (Hamilton (2000)) also find similar effects of large positive income shocks on entrepreneurship.

[4]This difference might be due to the cost the lender bears to keep track of the borrower, as assumed by Galor and Zeira (1993).

The skilled-unskilled wage differential must be high enough, so that those who can self-finance education do prefer this choice to remaining unskilled. This amounts to comparing (i) and (iii), which yields

$$v \geq [w(2+r) + h(1+r)] \qquad \text{for} \quad x \geq h \tag{2.1.5}$$

Given that the marginal product of skilled approaches ∞ as H_j tends to zero, this condition must hold in equilibrium.

Comparing (iii) to (iv) yields the level of threshold inheritance for the entrepreneurial choice:[5]

$$e = \frac{v - h(1+r) + g(1+i) - \pi}{i - r}. \tag{2.1.6}$$

Note that e is a function of H_j, $e = e(H_j)$, and $e' < 0$.

People with adequate wealth for entrepreneurship ($x \geq g$) will invest as an entrepreneur if their net-wealth from entrepreneurship is higher than that from investment in education. This is obtained by comparing (iii) and (v), as shown in the following constraint.

$$\pi \geq [v + (g-h)(1+r)] \tag{2.1.7}$$

In equilibrium, (2.1.7) will be satisfied. It is because, otherwise there will be no entrepreneur; since if it is too costly for people with inheritances $x \geq g$ to invest as entrepreneur because of too low profit, people with lower inheritances will always find it costlier to invest in entrepreneurship. With no entrepreneur, $H_j \to \infty$ which implies, $\pi \to \infty$ by (2.1.2) and then (2.1.7) will automatically get satisfied.

[5]We do not consider the incentive compatibility constraint of entrepreneurship for people with $x < h$. It is because, if it is satisfied, there will be no skilled worker, which can never be equilibrium.

In Figure 2.1 the indirect utility functions (or the net-wealth) are plotted for different inheritance levels taking into consideration the incentive compatibility constraints. The dark line segments show the highest attainable utility levels for each inheritance level. Clearly, people with inheritance $x < s$ will get highest utility if they invest as unskilled, people with inheritance $s \leq x < e$ will get highest utility if they invest as skilled and people with inheritance $x \geq e$ will derive highest utility if they invest as entrepreneur. Now, let us define unskilled ($x < s$) as poor (P), skilled ($s \leq x < e$) as middle class (M) and entrepreneur ($x \geq e$) as rich (R_i).

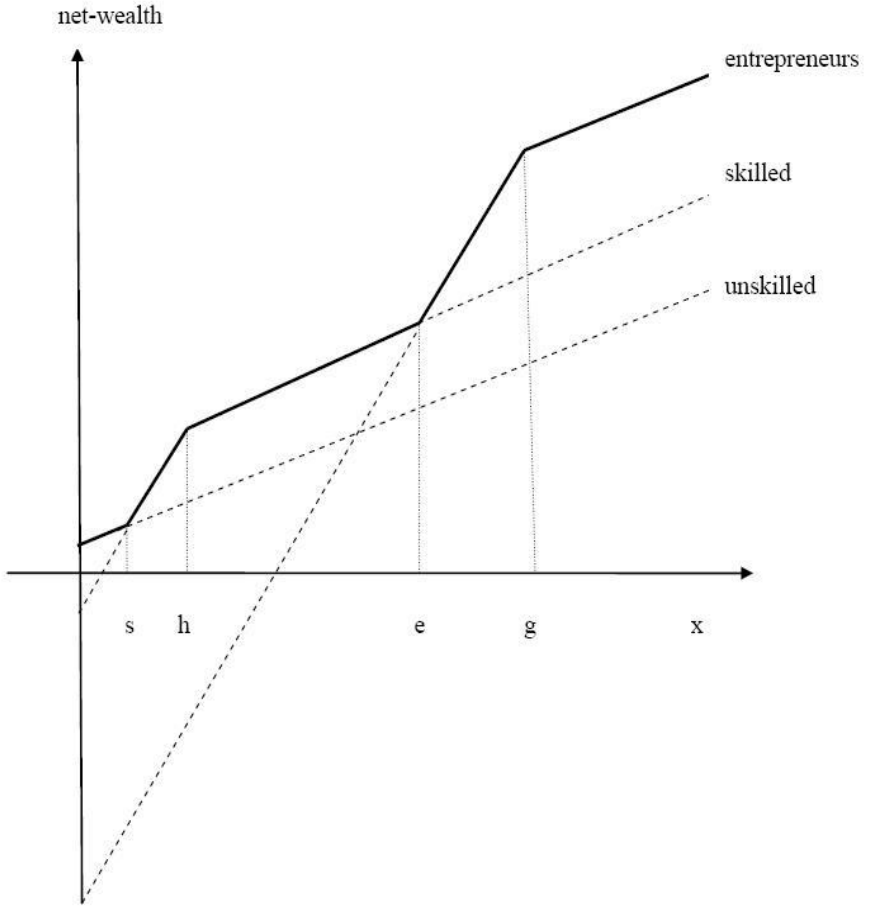

Figure 2.1: Net-wealth (utility) by occupational choice of agents

2.1.1 Equilibrium occupational-mix

Denoting the cumulative distribution of wealth by $F(\cdot)$, the number of entrepreneurs has the expression $1-F(e(H_j))$. The number of skilled laborers working in the economy is equal to $[F(e(H_j)) - F(s(H_j))]$. Hence,

$$H_j = \frac{F(e(H_j)) - F(s(H_j))}{1 - F(e(H_j))} \tag{2.1.8}$$

Note that the right-hand-side expression is a decreasing function of H_j, while the left-hand-side expression (obviously) is increasing. Furthermore, the right-hand-side expression approaches ∞ as $H_j \to 0$.[6] Thus the existence and uniqueness of solution of H_j is guaranteed.

For further characterization, we assume a Pareto distribution of wealth, a very standard form of distribution used in the literature, whose density function is given by

$$f(x) = \frac{\lambda m^{\lambda}}{x^{\lambda+1}}; \quad x \geq m > 0, \lambda > 0$$

where λ is the Pareto inequality parameter. The higher the value of λ, the greater is the number of people concentrated at the lower wealth levels, hence the higher is the degree of inequality.[7] The cumulative density function has the expression:

$$F(x) = \int_m^x \frac{\lambda m^{\lambda}}{X^{\lambda+1}} dX = 1 - \left(\frac{m}{x}\right)^{\lambda} \tag{2.1.9}$$

Using a Pareto distribution, the equilibrium H_j (H_j^*) is determined by:

$$H_j = \left[\frac{e(H_j)}{s(H_j)}\right]^{\lambda} - 1 \equiv \Gamma(H_j; \lambda) \tag{2.1.10}$$

[6] As $H_j \to 0$, we have $e \to \infty$ and $s \to -\infty$, respectively implying $F(e(H_j)) \to 1$ and $F(s(H_j)) \to 0$.
[7] See Chakravarty and Ghosh (2008) for the functional form of Pareto distribution used here.

This equation is same as (2.1.8). It is evident from (2.1.10) that $\partial\Gamma/\partial\lambda > 0$ as $e > s$. Thus, (a) Γ increases with λ; (b) H_j^* increases as Γ increases. Together, (a) and (b) imply that

$$\frac{dH_j^*}{d\lambda} > 0.$$

From this we get the next proposition.

Proposition 2.1.1. *(i) The higher the inequality level λ of an economy is, the higher is the skilled labor-entrepreneur ratio in equilibrium.*
(ii) There exist λ_{max} and λ_{min} such that all economies with inequality higher than λ_{max} will have minimum skilled wage (maximum profit) in equilibrium i.e., skilled laborer will get same income as the unskilled laborer in utility terms and all economies with inequality level lower than λ_{min} will have minimum profit (maximum skilled wage) i.e., entrepreneurs will get same income as skilled laborer in utility terms.[8]

The higher the inequality (higher λ), the higher is the number of people concentrated at the lower end of wealth distribution and the more is the number of credit-constrained people to become entrepreneur compared to the number of skilled people. Thus, for an economy with more inequality we have higher H_j^* at equilibrium. This implies, lower skilled wage and higher profit. Therefore, if the inequality level is very high equilibrium skilled wage (profit) will be very low (high) for that economy. More specifically, an unequal economy, defined by having an inequality parameter higher than or equal to λ_{max}, will have the minimum possible skilled wage that just satisfies the incentive compatibility constraint to invest in education, (2.1.5). Similarly, an economy with low inequality (defined by having inequality level lower than or equal to λ_{min}) will have more people concentrated at the higher wealth levels and more people can invest as entrepreneurs. These economies will have the minimum possible profit level that just satisfies the incentive compatibility constraint for entrepreneurs, (2.1.7), to invest in the set up cost.

[8] *See Appendix 2.1 for λ_{max} and λ_{min}.*

2.2 Welfare

The social welfare, W, is defined as:

$$W = \text{Total output (TO) - Net payments to the foreigners (NPF)}$$

where TO is the output of the home production sector (produced by the unskilled laborers of the economy) and that by the entrepreneurs in the other sector. People who do not have enough wealth to invest in education or in the set up cost borrow from the capital market. This is the total outflow of output from the economy. The total inflow of output includes returns from capital market enjoyed by the lenders of the economy. The gap between the total outflow and total inflow from the capital market measures the NPF. Thus,

$$TO = w\int_0^s f(x)dx + nY_j = w\int_0^s f(x)dx + nAH_j{}^{\gamma}$$

where n denotes the number of entrepreneurs of the economy and Y_j denotes the output produced by each entrepreneur j.

$$\begin{aligned} NPF = & \Big[(1+i)\{\int_s^h (h-x)f(x)dx + \int_e^g (g-x)f(x)dx\} - (1+r)\int_0^s (x+w)f(x)dx \\ & -(1+r)\{\int_h^e (x-h)f(x)dx + \int_g^{\infty} (x-g)f(x)dx\}\Big] \end{aligned}$$

Therefore,

$$\begin{aligned} W = & \; w\int_0^s f(x)dx + nAH_j{}^{\gamma} - \Big[(1+i)\{\int_s^h (h-x)f(x)dx + \int_e^g (g-x)f(x)dx\} \\ & -(1+r)\{\int_0^s (x+w)f(x)dx + \int_h^e (x-h)f(x)dx + \int_g^{\infty} (x-g)f(x)dx\}\Big] \end{aligned} \tag{2.2.1}$$

The objective of the planner is to obtain the number of entrepreneurs that maximizes the welfare. Here H_j depends on n and H_j can neither exceed H_j^{max} nor be less than H_j^{min}. Thus $H_j \in [H_j^{min}, H_j^{max}]$ where H_j^{min} solves (2.1.7) with equality and H_j^{max} solves (2.1.5) with equality.[9] Again, the total population can not exceed unity. Thus the problem to the planner is,

$$\begin{aligned} & max\, W \\ & \{n\} \\ \text{subject to,} \quad & H_j(n) \in [H_j^{min}, H_j^{max}] \text{ and } \phi + n + nH_j = 1 \end{aligned}$$

where $\phi = \int_0^s f(x)dx$ is the number of unskilled laborers or poor. Obviously, the planner chooses n in such a way that the incentive compatibility constraints for all the occupations are not violated.

Using Leibniz integral rule and setting $\frac{dW}{dn} = 0$ we get the first order condition,[10]

$$v\left[s'f(s) + nH_j{}'\right] + (\pi - v)e'f(e) + \frac{\pi}{1-\gamma} \;=\; 0 \tag{2.2.2}$$

where $s' = \frac{ds}{dn}, H_j{}' = \frac{dH_j}{dn}$ and $e' = \frac{de}{dn}$.

The welfare maximizing n, n^*, depends on λ since, $f(s)$ and $f(e)$ are Pareto density functions of λ. Suppose for some λ, λ^*, (2.2.2) is satisfied at $n = n^*(\lambda^*)$ and W is maximized. Notice that the first term in the left-hand-side of (2.2.2) is negative and the other two terms are positive since $s' < 0, e' > 0$ by (2.1.4) and (2.1.6), $H_j{}' < 0$ (obviously) and $\pi > v$. By Pareto density function, the higher the value of the inequality parameter λ, the higher is the concentration of people at the lower wealth s relative to that at e *i.e.*, value of $f(s)$ relative to that of $f(e)$ is higher. Therefore, at $n = n^*(\lambda^*)$ (hence at $H_j = H_j(n^*|\lambda^*)$) the left-hand-side of (2.2.2) will be $< (>)0$ for all $\lambda > (<)\lambda^*$. This implies $n^*(\lambda) < (>)n^*(\lambda^*)$ for all $\lambda > (<)\lambda^*$ since a lower (higher) n raises welfare.

[9] Note that n can never be zero since the incentive compatibility constraint for skilled laborer (2.1.5) gets violated. Thus we suppose the existence of a positive and finite n.

[10] Derived in Appendix 2.2.

Notice that the relation between λ and n^* is true for any λ since λ^* is arbitrarily chosen. Thus we find, $H_j(n^*|\lambda) > (<) H_j(n^*|\lambda^*)$ for all $\lambda > (<)\lambda^*$.[11] Now, $H_j(n^*|\lambda) > H_j(n^*|\lambda^*)$ for all $\lambda > \lambda^*$ implies social optimum v is lower which indicates the socially optimum number of unskilled laborers or poor is higher for all $\lambda > \lambda^*$. In Proposition 2.1.1 we saw that the private optimum ${H_j}^*$ also increases with inequality. Thus,

Proposition 2.2.1. *The social optimum skilled labor-entrepreneur ratio increases with the inequality level of an economy. The higher the inequality the lower is the social optimum number of entrepreneurs and the higher is the number of unskilled laborer.*

The intuition is quite obvious. We know that the agents who do not have enough wealth to invest as entrepreneurs borrow from the capital market which is a net outflow from the economy. An unequal economy has a lower concentration of people at the high wealth level or the number of lending entrepreneurs is low compared to the credit-constrained people. Thus, a high number of entrepreneurs in an unequal economy would cost more to the welfare via a net-outflow of the output, than it would to a relatively equal economy. On the other hand, the poor invest the entire inheritances in capital market that makes a positive inflow of output. Therefore, the welfare increases with an increase in the number of these net-lenders for an unequal economy.

Although both the social and private optimum level of skilled labor-entrepreneur ratio are increasing functions of inequality level, there is no reason to believe that the two values will match for all inequality levels. The basic cause of such difference lies in the fact that in private optimum individuals maximize their *own* net-wealth separately whereas in choosing the social optimum the planner maximizes the net-wealth of the *entire* economy that includes the net-wealth of both the lenders and borrowers.

[11] Suppose $H_j(n^*|\lambda)$ is lower for an economy with higher $\lambda(> \lambda^*)$ although n^* is lower $(n^*(\lambda) < n^*(\lambda^*))$ for the economy. This implies the number of skilled is definitely lower for this economy since $H_j = \frac{H}{n}$ and n is lower. Now, a lower H_j implies a higher v, hence a lower s and lower number of poor too. This contradicts the assumption that all economies have same and constant number of agents.

Now, we know that for $\lambda = \lambda_{max}$, equilibrium private optimum $H_j{}^* = H_j^{max}$ and for $\lambda = \lambda_{min}$, $H_j{}^* = H_j^{min}$ where λ_{max} and λ_{min} are defined in Appendix 2.1, and H_j^{max} and H_j^{min} are the maximum and minimum possible values of the skilled labor-entrepreneur ratio respectively, satisfying the incentive compatibility constraints of occupational investments. Thus, for highly unequal economies defined as $\lambda \geq \lambda_{max}$, we find that $H_j(n^*|\lambda) \leq H_j{}^* = H_j^{max}$ *i.e.*, the social optimum can not exceed the private optimum and for highly equal economies, defined as $\lambda \leq \lambda_{min}$, $H_j(n^*|\lambda) \geq H_j{}^* = H_j^{min}$ *i.e.*, the social optimum can not be less than the private optimum.

When the private optimum is higher than the social optimum, which might be the case for a highly unequal economy, the optimum policy should be the one which reduces the private optimum. Similarly, the suitable policy for a highly equal economy is that which raises the private optimum $H_j{}^*$ when the private optimum is lower than the social optimum, and no policy is required when the private optimum exactly matches with the social optimum. Therefore,

Remark 2.2.1. *Education subsidy is not an appropriate policy for highly unequal economies but it might be helpful for highly equal economies when the private optimum is lower than the social optimum.*

Education subsidy reduces education cost and increases the private optimum value of skilled labor-entrepreneur ratio. We have seen that an unequal economy either has the private optimum above the social optimum or the private optimum exactly matches with the social optimum. In the first case education subsidy obviously does not help to reach the social optimum whereas in the second case it is not required at all. However, for an equal economy, we know that the private optimum lies either below the social optimum or it equals the social optimum. In the first case education subsidy is a suitable policy since it increases the private optimum and helps to reach the social optimum.

2.3 Dynamics

From the preference functions in Section-2.2, we find that a fraction $(1-\delta)$ of the net-wealth is kept as bequest by each individual. Therefore, the bequest dynamics is as follows.

$$x_{t+1} = \begin{cases} (1-\delta)[(x_t+w)(1+r)+w] & ; x_t < s_t \\ (1-\delta)[(x_t-h)(1+i)+v_t] & ; s_t \leq x_t < h \\ (1-\delta)[(x_t-h)(1+r)+v_t] & ; h \leq x_t < e_t \\ (1-\delta)[(x_t-g)(1+i)+\pi_t] & ; e_t \leq x_t < g \\ (1-\delta)[(x_t-g)(1+r)+\pi_t] & ; x_t \geq g \end{cases}$$

Let us start with the assumption $(1-\alpha)(1+r) < 1 < (1-\alpha)(1+i)$, *i.e.*, there is sufficient degree of capital market imperfection.[12]

The skilled-entrepreneur ratio at any time t is defined as,

$$H_{jt} = \frac{H_t}{n_t}$$

where H_t is the number of skilled laborers employed by n_t number of entrepreneurs at time t. We get the change in H_{jt} with respect to time as:

$$\frac{dH_{jt}}{H_{jt}} = \frac{dH_t}{H_t} - \frac{dn_t}{n_t}$$

Since the sequence of values of v and π, hence the entire dynamics of the model, depends upon the sequence of values of H_j the long run convergence of wealth is achieved when H_j converges. Now, equilibrium v can not fall below the lower bound provided by the incentive compatibility constraint of skilled laborers (2.1.5) which gives the upper bound for H_j (since, v is a decreasing function of H_j). Similarly, equilibrium π can not fall below the lower bound provided by the incentive compatibility constraint of entrepreneurs (2.1.7) which gives the lower bound for H_j (since, π is a increasing function of H_j). The long run convergence is tested in a calibration exercise in this section.

[12] Following Galor and Zaire (1993).

In the long run three possibilities are there. The long run wealth of the middle class people (or the skilled people) converges to a wealth level between the long run wealth levels of the rich and poor. Another possibility is that, the wealth of the poor and middle class people converge to a same level *i.e.*, they derive same utility in the long run and the long run wealth of rich people converges to a higher wealth level. The third possibility is, wealth of the rich and middle class people converge to a same level *i.e.*, they derive same utility in the long run and the long run wealth of the poor converge to a lower wealth level. In the long run all the values including the inheritance values (x) converge. Therefore, we get the long run values of wealth for the three group of people by setting $x_{t+1} = x_t$ in the above equations in the dynamics of wealth levels for different individuals and obtain the long run wealth levels as follows.

$$\begin{aligned}
\text{Long Run Wealth of Poor: } x^P &= \frac{(1-\delta)w(2+r)}{1-(1-\delta)(1+r)} \qquad (a)\\
\text{Long Run Wealth of Middle Class: } x^M &= \frac{(1-\delta)[v^* - h(1+r)]}{1-(1-\delta)(1+r)} \qquad (b)\\
\text{Long Run Wealth of Rich: } x^{R_i} &= \frac{(1-\delta)[\pi^* - g(1+r)]}{1-(1-\delta)(1+r)} \qquad (c)
\end{aligned}$$

where v^* and π^* are the long run values of equilibrium v and π respectively.

Three possibilities are there in the long run:
(i) $x^P < x^M < x^{R_i}$, (ii) $x^P < x^M = x^{R_i}$, (iii) $x^P = x^M < x^{R_i}$.
When v^* is at the minimum, *i.e.*, $v^* = [w(2+r) + h(1+r)]$, $x^P = x^M < x^{R_i}$ and when π^* is at the minimum, *i.e.*, $\pi^* = [v^* + (g-h)(1+r)]$, $x^P < x^M = x^{R_i}$.

2.3.1 Calibration

The purpose of this calibration exercise is to test and analyze the long run convergence of wealth levels driven by the changes in the values of the bequest functions for the three groups of people. The description of the data used with their sources are as follows.

The daily level unskilled wage data, provided by Monthly Economic Review, 2005,[13] is taken as Rs. 62.44. It has been converted to monthly wage taking five working days per week and then to yearly data. Their data source is Indian labor Journal, labor Bureau, on the basis of recommendations made by National Sample Survey Organisation (NSSO). The data of borrowing and lending interest rates (for one year deposit or borrowing) have been taken 9% and 6% respectively, within the ranges of Axis Bank, India rates. Data source is Axis Bank Treasury, Central Office. The yearly data of education cost, Rs. 1439, has been taken around the values of data obtained in a study by International Comparative Higher Education Finance and Accessibility Project (ICHEFAP), 2002.[14] The data of set up cost has been taken as Rs. 2740, within the range of values of the yearly data of fixed investment cost of some industries, in the factory sector dataset of Annual Survey of Industries, India (2001-2002). Both the values of h and g have been converted in terms of w dividing their values by that of yearly w. The yearly unskilled wage is used as numeraire in the calibration. A standard production function has been taken from the literature with the share of skilled labor (α) and that of capital (β) in production, taken from the estimation of Kendrick (1976), .4 and .35 respectively.[15] These values are closer to the values estimated by Mankiw, Romer and Weil (1992).[16] The value of the parameter for parental altruism has been taken from standard literature as 0.32. The value of the exponent of Pareto distribution is taken from the estimation of Sinha (2005) which is 1.15 for India.

We assume a generation lives as young for 20 years and then joins the respective occupation. Working age limit and lifetime has been taken as 60. This implies a skilled

[13]Monthly Economic Review, India. December 2005.
Website: $http://www.epwrf.res.in/upload/MER/mer10510011.htm$
[14]Website of ICHEFAP:
$http://www.gse.buffalo.edu/org/inthigheredfinance/region\_asia\_India.html$
[15]Romer (1996), pp. 134.
[16]Romer (1996), pp. 140.

laborer acquires education for 20 years when he is young and then joins the workforce for the next 40 years of his lifetime. For this he compares his total cost of investing in education for 20 years and then gross skilled wages in the rest of his life with the gross returns if he instead remains unskilled for the entire 60 years of his lifetime. The borrowers compare the entire series of loan repayments for the period of 20 years of education added with the flow of skilled wages he would get on joining the skilled labor force with his opportunity cost (series of unskilled wages forgone). Entrepreneurs invest in set up cost when young (for the first 20 years of their lifetime) and then start production in the next 40 years. The set up cost may be lumpy in the sense that the spread of the total set up cost is not even over all the 20 years when the entrepreneur is young. Comparison of net-wealth with the opportunity costs gives the wealth thresholds for skilled workers and entrepreneurs.

Results

The lower bound and upper bounds of H_j^* are calculated from the incentive compatibility constraint of entrepreneurs (2.1.7) and that of skilled laborers (2.1.5) respectively. It is found that H_j^* declines and then converges. Convergence of H_j^* implies convergence of all the endogenous variables of the model and hence convergence of the wealth distribution. Table 2.1 below shows the values of skilled wage (v^*) and profit (π^*) for several iterations till convergence. Putting long run v^* and π^* in (a), (b) and (c) adjusted with the rate of interests forgone we get the long run wealth levels for the three groups of people as: $x^P = 0.00853$, $x^M = 0.15268$ and $x^{R_i} = 0.19807$. It is interesting to note that the long run wealth levels of rich and middle class are very close while both of them are much above the long run wealth level of poor.

Table 2.1: Values of v^* and π^* till convergence

v^*	π^*
10.2238854223	10.3279461696
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137
10.2284939027	10.3205019137

2.4 Conclusion

The chapter relates wealth inequality of an economy and occupational choice of the economic agents by a two-period overlapping generations framework. The model tries to find an optimal mix of the two occupations - entrepreneur and skilled laborer by welfare maximization. Assuming rational expectation behavior of economic agents and taking Pareto distribution for wealth, it finds that the higher the inequality parameter the higher will be the number of skilled laborers employed by an entrepreneur in equilibrium. Given the fact that the market forces may not behave in a way that the private optimum matches with the social optimum, the chapter shows that for highly unequal economies the deviation between the private and the social optimum can not be corrected by an education subsidy, which is in sharp contrast to the usual belief. In case of an equal economy, however, it might be an appropriate policy to reach the social

optimum when the private optimum deviates from the social optimum.

The calibration exercise shows for the particular set of data that the long run convergence of the wealth distribution is attained in this kind of dynamic framework and interestingly, the long run wealth levels of the middle class and that of the rich are very close to each other and much above the long run wealth of the poor.

Nonetheless, there are real life evidences where people belonging to 'middle class' run enterprises and people belonging to the 'rich section' decide over human capital accumulation. Wealth can provide a partial explanation of the occupational choice behavior of individuals. Social factors and differences in inherent ability are there, as well, to explain it. These are left for further consideration.

2.5 Appendix

Appendix 2.1: Proposition 2.1.1 (ii) - values of λ_{max} and λ_{min}

We have seen that whatever be the value of λ for an economy, the incentive compatibility constraint for the skilled (2.1.5) will automatically get satisfied. Again, we saw in Proposition 2.1.1(i), the higher the inequality, the higher is equilibrium H_j which implies, a lower equilibrium v, v^*, by (2.1.1).

Now, let us define λ_{max} such that for $\lambda = \lambda_{max}$, we get the minimum value of v^*, v^{min} where $v^{min} = [(w+h)(1+r)+w]$. Using (2.1.1) we can easily solve for the H_j^* that solves $v^* = v^{min}$, say H_j^{max}, as follows.

$$\begin{aligned} v^{min} &= \alpha A^{\frac{1}{1-\beta}} \left(\frac{\beta}{r}\right)^{\frac{\beta}{1-\beta}} {H_j^{max}}^{\frac{\alpha+\beta-1}{1-\beta}} = [(w+h)(1+r)+w] \\ or, \quad H_j^{max} &= \left(\frac{\alpha c_1}{(w+h)(1+r)+w}\right)^{\frac{1-\beta}{1-(\alpha+\beta)}} \end{aligned}$$

where $c_1 = A^{\frac{1}{1-\beta}} \left(\frac{\beta}{r}\right)^{\frac{\beta}{1-\beta}}$. Putting this in the right-hand-side of (2.1.10) we get,

$$\begin{aligned} \left(\frac{e}{s}\right)^{\lambda} - 1 = H_j^{max} &= \left(\frac{\alpha c_1}{h(1+r)+w(2+r)}\right)^{\frac{1-\beta}{1-(\alpha+\beta)}} \\ or, \quad \lambda \ln\left(\frac{e}{s}\right) &= \ln\left[\left(\frac{\alpha c_1}{h(1+r)+w(2+r)}\right)^{\frac{1-\beta}{1-(\alpha+\beta)}} + 1\right] \end{aligned} \tag{A2.1}$$

When $v = [h(1+r)+w(2+r)]$ we find,

$$\left(\tfrac{e}{s}\right) = \left[\tfrac{v-h(1+r)+g(1+i)-\pi}{w(2+r)+h(1+i)-v}\right] = \left[\frac{w(2+r)+g(1+i)-c_1\{1-(\alpha+\beta)\}\left(\frac{\alpha c_1}{h(1+r)+w(2+r)}\right)^{\frac{\alpha}{1-(\alpha+\beta)}}}{h(i-r)}\right]$$

Therefore, from (A2.1) we obtain,

$$\lambda_{max} = \frac{\ln\left[1+\left(\frac{\alpha c_1}{h(1+r)+w(2+r)}\right)^{\frac{\alpha}{1-(\alpha+\beta)}}\right]}{\ln\left[\frac{w(2+r)+g(1+i)-c_1\{1-(\alpha+\beta)\ \}\left(\frac{\alpha c_1}{h(1+r)+w(2+r)}\right)^{\frac{\alpha}{1-(\alpha+\beta)}}}{h(i-r)}\right]}$$

Now, for all economies with inequality $\lambda > \lambda_{max}$, $H_j^* = H_j^{max}$ (by Proposition 2.1.1(i)) implying $v^* = v^{min} = [w(2+r)+h(1+r)]$ (or, profit will be maximum) otherwise (2.1.5) will be violated.

Similarly, at the other extreme, when inequality level is very low, by Proposition 2.1.1(i) H_j^* will low implying a low profit. Let us define λ_{min} such that for $\lambda = \lambda_{min}$, we get the minimum value of π^*, $\pi^* = [v^* + (g-h)(1+r)]$. Using (2.1.2) and (2.1.1) we can easily solve for H_j^*, say H_j^{min}, as follows.

$$\begin{aligned} \pi &= v + (g-h)(1+r) \\ or, \quad \{1-(\alpha+\beta)\}c_1 H_j^{\frac{\alpha}{1-\beta}} &= \alpha c_1 H_j^{\frac{\alpha+\beta-1}{1-\beta}} + (g-h)(1+r) \\ or, \quad c_1 H_j^{\frac{\alpha}{1-\beta}}\{1-(\alpha+\beta)-\frac{\alpha}{H_j}\} &= (g-h)(1+r) \end{aligned}$$

The above equation gives a unique H_j^{min}. Thus from (2.1.6) and (2.1.4) we get,

$$\left(\frac{e}{s}\right) = \left[\frac{g(i-r)}{w(2+r)+h(1+i)-c_1\alpha H_j^{min\,\frac{\alpha+\beta-1}{1-\beta}}}\right]$$

At $\pi^* = v^* + (g-h)(1+r)$ *i.e.*, $H_i = H_j^{min}$, we get from (2.1.10),

$$\begin{aligned} \left(\frac{e}{s}\right)^{\lambda} - 1 &= H_j^{min} \\ or, \quad \lambda_{min} &= \frac{\ln\left[1+H_j^{min}\right]}{\ln\left[\frac{g(i-r)}{w(2+r)+h(1+i)-c_1\alpha H_j^{min\,\frac{\alpha+\beta-1}{1-\beta}}}\right]} \text{ (putting } \left(\frac{e}{s}\right) \text{ from above)} \end{aligned}$$

Now, for all economies with inequality $\lambda < \lambda_{min}$, by Proposition 2.1.1(i), $\pi^* = [v + (g-h)(1+r)]$ (or, v^* will be maximum) since π^* can not fall below $[v + (g-h)(1+r)]$, otherwise (2.1.7) will be violated. Hence the proposition.

Appendix 2.2: Welfare Maximization

$$\begin{aligned} W &= w\int_0^s f(x)dx + nAH_j{}^{\gamma} - \Big[(1+i)\{\int_s^h (h-x)f(x)dx + \int_e^g (g-x)f(x)dx\} \\ &\quad -(1+r)\{\int_0^s (x+w)f(x)dx + \int_h^e (x-h)f(x)dx + \int_g^{\infty} (x-g)f(x)dx\}\Big] \end{aligned}$$

Denote, $s' = \frac{ds}{dn}, H_j{}' = \frac{dH_j}{dn}$ and $e' = \frac{de}{dn}$.

Differentiating W w.r.t. n using Leibniz integral rule we get,

$$\begin{aligned} \frac{dW}{dn} &= ws'f(s) + AH_j{}^{\gamma} + nA\gamma H_j{}^{\gamma-1}H_j{}' + (1+i)s'(h-s)f(s) + (1+i)e'(g-e)f(e) \\ &\quad +(1+r)s'(s+w)f(s) + (1+r)e'(e-h)f(e) \\ &= \frac{\pi}{1-\gamma} + nvH_j{}' + s'f(s)\left[w + h(1+i) - (1+i)s + s(1+r) + w(1+r)\right] \\ &\quad +e'f(e)\left[g(1+i) - e(1+i) + e(1+r) - h(1+r) - \pi + v + \pi - v\right] \\ &= \frac{\pi}{1-\gamma} + nvH_j{}' + s'f(s)\left[-(i-r)s + w(2+r) + h(1+i) - v + v\right] \\ &\quad +e'f(e)\left[-e(i-r) + g(1+i) - h(1+r) - \pi + v + \pi - v\right] \\ &= \frac{\pi}{1-\gamma} + nvH_j{}' + s'f(s)v + e'f(e)(\pi - v) \end{aligned}$$

Therefore,

$$\frac{dW}{dn} = v\left[s'f(s) + nvH_j{}'\right] + e'f(e)(\pi - v) + \frac{\pi}{1-\gamma}$$

Chapter 3

Wealth Inequality and Migration Incentives

Introduction[1]

The current wave of globalization has induced a large pool of skilled people to migrate to places where they are best rewarded. Quite predictably, the bulk of migration has taken place from less developed to more developed nations with the United States being a major recipient of skilled workers from other countries. However, empirical evidence suggests that the nature of migration from less developed countries has been far from uniform and has widely varied with respect to the skilled-unskilled mix. Hao (2003) finds that only 7.6% of Hispanic immigrants in the United States during the 1980s and 1990s are in the highly skilled category (with Bachelor degrees or higher) compared to 44.3% for Asian immigrants. Similarly, Martin (2003) shows that throughout the 1990s the number of H-1B visas (meant for skilled workers) issued by the United States is uniformly higher for Indians than for mainland Chinese, as shown in Table 3.1.

On the other hand, starting from pre-1965 to post-1984, 16.6% of Chinese immigrants

[1]**This chapter is based on Roy Chowdhury (2008).**

Table 3.1: H1-B Visas Issued to China and India: 1992-99

	1992	1993	1994	1995	1996	1997	1998	1999
China	894	1,031	1,256	1,887	2,330	3,214	3,883	5,779
India	5,552	7,606	11,301	15,528	19,203	31,686	40,247	55,047

Data Source: U.S. Department of State, Visa Office

in the United States had no high school degree (or were in the unskilled category) compared to 7.2% in the case of Indian immigrants.[2] The purpose of this chapter is to understand why the mix of skilled-unskilled migration may vary across source countries.

We also observe that income and wealth disparities vary considerably across nations. For example, De Ferranti et al. (2004) show that Latin America is much more unequal than Asia. While the overall Gini Coefficient between the 1970s and the 1990s was 50.5 for Latin America, it was only 40.6 for Asia.[3] Within Asia, there is more inequality in China than in India. The inequality in China is more comparable to the Philippines, a highly unequal country.[4] According to World Bank's Human Development Report (2004), the Gini Coefficient in 2000-2001 was 32.5 for India and 44.7 for China.[5]

If we combine these pieces of evidence, it seems that for highly unequal economies skilled emigration is negligible, while unskilled labor migration is relatively substantial. This chapter tries to explain the above observations by providing a theoretical model of inequality, occupational choice and migration incentives of the agents in an economy.

The basic model assumes that a person has to incur an indivisible cost for acquiring education and an additional indivisible cost to migrate. On the other hand, to become

[2]See Hao (2003), Table 2, pp. 33.
[3]See De Ferranti et al. (2004), Table 2.1.
[4]See Khan and Riskin (2001), pp. 43.
[5]Human Development Report (2004), pp. 189-190.
Website: *http* : *//hdr.undp.org/en/media/hdr*04*_complete.pdf*

an entrepreneur one has to incur a set up cost, higher than the total cost of education and migration.[6] If the capital market is imperfect,[7] the decision of a credit-constrained individual to choose an occupation will crucially depend upon the level of wealth he inherits, the expected profit and the skilled wage. Equilibrium profit, the skilled wage and the unskilled wage are determined by the joint decisions of all the agents. These decisions depend upon the wealth distribution. Therefore, the distribution of wealth in an economy is a crucial determinant of the skilled labor-entrepreneur composition of the economy. If the number of entrepreneurs is very small (skilled labor-entrepreneur ratio is very high), the profit enjoyed by each entrepreneur will be very high and the gain (net of cost) from entrepreneurship may be higher than the net return from migration. It is shown that the higher the inequality, *i.e.*, the higher the concentration of people with lower wealth, the higher will be the skilled labor to entrepreneur ratio which in turn reduces the skilled wage and raises returns to entrepreneurship. On the other hand, the number of people investing in education reduces in such an unequal economy since there is a fixed education cost. This human-capital supply effect causes a disincentive to migrate but the fall in skilled wage raises such an incentive. If inequality is high enough, the first effect dominates and we find a negative impact on migration.

Stark (2006) also analyzes the link between inequality and migration but reaches a different conclusion. He shows that a higher total relative deprivation of a population leads to a stronger incentive to engage in migration for a given level of a population's income. His model does not have heterogeneous agents engaged in occupational choice and the role of credit-constraints has not been emphasized, as in this chapter.[8]

[6]There are studies which support and empirically justify that entrepreneurs are from the richer section of the wealth distribution. Evans and Jovanovic (1989) were among the first to find the determinants of entrepreneurship, focusing on the effects of receiving large bequests on the probability of becoming entrepreneurs. Subsequent studies, for example Hamilton (2000), also find similar effects of large positive income shocks on entrepreneurship.

[7]The assumption of capital market imperfection is very common in the literature of economic development. See for example, Galor and Zeira (1993), Banerjee and Newman (1993).

[8]See Rapoport (2002) and Mesnard (2004) for analyses of migration and occupational choice in other

The chapter also considers unskilled labor migration and shows that too much inequality can be a cause of unskilled labor migration. It is because of a high concentration of people at the low wealth level for a highly unequal economy that keeps the autarkic unskilled wage very low. Hence, the skilled-unskilled wage differential *as well as* the skilled labor-entrepreneurs ratio are shown to have strong bearing towards the incentive to migrate.

The chapter is organized as follows. Section 3.1 provides the basic model of occupational choice, in which the unskilled wage is fixed. Variable unskilled wage is considered in Section 3.2 and the pattern of skilled and unskilled labor migration from an economy with a given inequality level are discussed. Section 3.3 provides the concluding remarks. The Appendix in Section 3.4 contains derivations of few results given in the main text.

3.1 The basic model

The model utilizes a two-period overlapping generations (OLG) framework. There are infinitely many altruistic people with population normalized to unity. It is a small open economy with international capital mobility, facing a given rate of interest from abroad. The credit market is imperfect with a gap between the lending and borrowing rates. There is only one good. It can be produced in two sectors: one with only unskilled laborer (home production type) and the other in which entrepreneurs employ skilled workers. Full employment prevails in both the labor markets.

In this section we consider the case where only skilled laborer can migrate. In the first period of his life, an agent receives an inheritance and decides his occupational choice.

contexts.

If he decides neither to undertake education nor become an entrepreneur, he invests his wealth in the capital market and works as unskilled in the first period. Otherwise, he may choose to invest in education and become a skilled worker and then decide whether to incur the migration cost to migrate or to work as a skilled worker in the domestic economy. Or he may choose to invest in the set up cost and become an entrepreneur.

To make any of the above investment decisions, he may borrow from the capital market if he does not have adequate wealth. In case he has adequate wealth, he makes the desired investment and lends the rest of his inheritance in the capital market.

In the second period of his life, each individual earns according to the investment made in first period (unskilled people continue to work as unskilled laborers in the second period), consume, and leave a bequest.

Technologies

The home production sector uses unskilled labor under a linear technology, $Y = wL$, where L denotes unskilled laborer and w is unskilled wage. In the other sector, an entrepreneur, j, hires skilled laborer and faces the production function:

$$Y_j = AH_j^{\gamma}; \quad 0 < \gamma < 1 < A$$

where A is a technology parameter and H_j the skilled laborers employed by him.

Diminishing returns to scale implies the presence of some fixed factor, which can be interpreted as fixed entrepreneurial effort. By the full employment assumption, H_j is actually the ratio of total number of skilled people that remain within the economy and work in the skilled sector to the total number of entrepreneurs of the economy.

Notice the distinguishing feature of this two-sector model that unskilled and skilled laborer are not directly substitutable in production, while skilled labor and entrepreneurial efforts are.

Let v denote the skilled wage. The profit of an entrepreneur is equal to $\pi_j = Y_j - H_j v$. The profit-maximizing level of the skilled labor employment is determined by

$$v = A\gamma H_j^{\gamma-1} \tag{3.1.1}$$

Assuming that entrepreneurial efforts are same across all entrepreneurs,

$$\pi_j = A(1-\gamma)H_j^{\gamma} = \pi \tag{3.1.2}$$

Eqs. (3.1.1) and (3.1.2) respectively define

$$v = v(H_j); \quad \pi = \pi(H_j) \tag{3.1.3}$$

Once H_j is determined, v and π are known via these functions.

Preferences and occupational choice

The utility function is defined over consumption, c, and the bequest, b: $U = c^{\delta}b^{1-\delta}$, where $0 < \delta < 1$. In period 2, this is maximized subject to, $b + c \leq Z$, where Z denotes net-wealth in period 2. Z equals:

$(x+w)(1+r)+w;$	if he decides to remain unskilled	(i)
$(x-h)(1+i)+v;$	if he invests in education and is a borrower	(ii)
$(x-h)(1+r)+v;$	if he invests in education and is a lender	(iii)
$(x-\rho-h)(1+i)+v_f;$	if he decides to migrate and is a borrower	(iv)
$(x-\rho-h)(1+r)+v_f;$	if he decides to migrate and is a lender	(v)
$(x-g)(1+i)+\pi;$	if he invests in set up cost and is borrower	(vi)
$(x-g)(1+r)+\pi;$	if he invests in set up cost and is lender	(vii)

Here x is the inheritance, v_f is the exogenously given foreign skilled wage, h is the indivisible education cost, ρ denotes the indivisible migration cost and g is the indivisible set up cost of entrepreneurs.

We assume that $g > h + \rho$. Also, the borrowing rate, i, exceeds the lending rate, r. This is the source of capital market imperfection in the model.[9]

As the indirect utility function is increasing in Z, in period 1, the objective is to maximize Z, or the net-wealth. A person decides to invest in education if his net-wealth by investing in education does not fall short of that he would receive if he remains unskilled. Let s denote the threshold inheritance above which a person decides to invest in education. By comparing (i) and (ii) we get s for $x < h$ as,

$$s = \frac{w(2+r) + h(1+i) - v}{i - r} \tag{3.1.4}$$

In view of the function $v(H_j)$, s is a function of H_j, $s(H_j)$. We have $s' > 0$ as $v'(H_j) < 0$; this is intuitive.

The skilled-unskilled wage differential must be high enough, so that those who can self-finance education do prefer this choice to remaining unskilled. This amounts to comparing (i) and (iii), which yields

$$v \geq w(2+r) + h(1+r) \quad \text{for } x \geq h \tag{3.1.5}$$

Given that the marginal product of skilled laborer approaches ∞ as H_j tends to zero, this condition must hold in equilibrium.

Now, consider the migration decision by skilled people. Define another threshold inheritance level M, above which an individual prefers to migrate. This is obtained by

[9]This difference might be due to the cost the lender bears to keep track of the borrower, as assumed by Galor and Zeira (1993).

comparing the net-wealth of an individual who would borrow and invest as a skilled migrant rather than invest in education and work in the domestic economy. Comparing (iii) to (iv),[10]

$$M = \frac{h(i-r) + \rho(1+i) - v_f + v}{i-r} \quad \text{for } h \leq x < \rho + h \tag{3.1.6}$$

Given that v is a function of H_j, we have $M = M(H_j)$ with $M' < 0$.

The incentive compatibility constraint for the people who have adequate wealth to invest as a skilled migrant is obtained by comparing (iii) and (v).

$$v_f - \rho(1+r) \geq v \quad \text{for } x \geq \rho + h \tag{3.1.7}$$

Given that (3.1.5) always holds, from (3.1.7) it is clear that those who decide to migrate will never choose to work as unskilled since they will never get higher utility from working as unskilled than becoming skilled and then migrating.

Comparing (iii) to (vi) yields the level of threshold inheritance for the entrepreneurial choice:[11]

$$e = \frac{v - h(1+r) + g(1+i) - \pi}{i-r} \tag{3.1.8}$$

Note that e is a function of H_j, $e = e(H_j)$, and $e' < 0$.

Will it be a better option to invest in set-up cost rather than borrowing and migrating? For this, we compare (iv) and (vi) and obtain the following incentive compatibility

[10]Note that in equilibrium, migration will not be incentive compatible for people with $x < h$. Because if it is satisfied for them, then it must also be satisfied for other skilled people with higher inheritances, since they borrow a lesser (if at all) amount of wealth to migrate and thus will have higher net-wealth from migration. As a result, there will be no skilled workers in the economy (*i.e.*, $H_j = 0$). But this can never be an equilibrium – as we have argued earlier – and an equilibrium with no migration choice for them will be restored.

[11]We do not consider the incentive compatibility constraint of entrepreneurship for people with $x < h$. It is because, if it is satisfied, there will be no skilled worker, which can never be equilibrium.

constraint of entrepreneurship for people with $x < \rho + h$.

$$\pi \geq (g - h - \rho)(1 + i) + v_f \equiv \pi_2 \tag{3.1.9}$$

By comparing (3.1.6) and (3.1.8), observe that $M(H_j) \gtreqless e(H_j)$ as $H_j \gtreqless \pi^{-1}(\pi_2)$. It is clear that if the incentive compatibility condition for entrepreneurship is satisfied for $x < \rho + h$, it is also satisfied for the people with $x \geq \rho + h$, since they borrow less (if at all) compared to people with $x < \rho + h$.[12]

People with $x \geq g$ will invest as an entrepreneur if their net-wealth from entrepreneurship is higher than that from migration:

$$\pi \geq v_f + (g - \rho - h)(1 + r) \tag{3.1.10}$$

which is obtained by comparing (v) and (vii). In equilibrium, (3.1.10) will be satisfied, because, otherwise there will be no entrepreneurs and no employment of skilled laborer. Also note that if a person decides to invest as an entrepreneur he would get higher utility compared to what he would derive if he instead works as unskilled; otherwise, there will be no entrepreneurs, which can never be an equilibrium, as we have just seen.

All the relevant inequalities that must hold have been stated in terms of given values of v and π. In turn, v and π are determined by H_j. Lemma 3.1.1 below identifies the ranges of H_j for which there is positive or zero migration.

Define $\pi_1 \equiv (g - h - \rho)(1 + r) + v_f$.

Lemma 3.1.1. *Skilled labor migration occurs or does not occur accordingly as* $H_j \in (\pi^{-1}(\pi_1), \pi^{-1}(\pi_2))$ *or* $H_j > \pi^{-1}(\pi_2) > \pi^{-1}(\pi_1)$.[13]

[12] If (3.1.9) is violated, people with $x < (\rho + h)$ will never invest as entrepreneurs. In this case, we have seen that $e > M$, *i.e.*, there exists some people with $M \leq x < e$ who will migrate.

[13] Note that $H_j < \pi^{-1}(\pi_1)$ can never occur in equilibrium otherwise the incentive compatibility constraint for entrepreneurship (3.1.10) will be violated. The proof of Lemma 3.1.1 is provided in Appendix 3.1.

The higher the level of skilled labor employment, the higher will be the profit and the incentive to become an entrepreneur. Lemma 3.1.1 says that if it is high enough, people will prefer to become entrepreneurs rather than becoming skilled and migrating; there will be no migration. On the other hand, if H_j is not so high, profit will not be high enough and there will be some skilled individuals who would prefer to migrate.

3.1.1 Inequality and skilled labor migration

Denoting the cumulative distribution of wealth by $F(\cdot)$, the number of entrepreneurs has the expression $1 - F(e(H_j))$. If there is migration, the number of skilled laborers working in the economy is equal to $[F(M(H_j)) - F(s(H_j))]$. Hence,

$$H_j = \frac{F(M(H_j)) - F(s(H_j))}{1 - F(e(H_j))} \tag{3.1.11}$$

This equation determines H_j. Under no migration, the corresponding equation is:

$$H_j = \frac{F(e(H_j)) - F(s(H_j))}{1 - F(e(H_j))} \tag{3.1.12}$$

Note that in each of the last two equations, the right-hand-side expression is a decreasing function of H_j, while the left-hand-side expression (obviously) is increasing. Furthermore, the right-hand side expressions approach ∞ as $H_j \to 0$.[14] Thus the existence and uniqueness of solution of H_j is guaranteed for both equations.

For further characterization, we assume a Pareto distribution of wealth, a very standard form of distribution used in the literature, whose density function is given by

$$f(x) = \frac{\lambda m^\lambda}{x^{\lambda+1}}; \quad x \geq m > 0, \lambda > 0$$

where λ is the Pareto inequality parameter. The higher the value of λ, the greater is the number of people concentrated at the lower wealth levels, hence the higher is the degree

[14] As $H_j \to 0$, we have $M \to \infty$, $s \to -\infty$ and $e \to \infty$, respectively implying $F(M(H_j)) \to 1$, $F(s(H_j)) \to 0$ and $F(e(H_j)) \to 1$.

of inequality. The cumulative density function has the expression:

$$F(x) = \int_m^x \frac{\lambda m^\lambda}{X^{\lambda+1}} dX = 1 - \left(\frac{m}{x}\right)^\lambda \tag{3.1.13}$$

Using a Pareto distribution, the equilibrium H_j in case of migration (say H_1^*) and that in case of no migration (say H_2^*) are determined respectively by:

$$H_j = \left[\frac{e(H_j)}{s(H_j)}\right]^\lambda - \left[\frac{e(H_j)}{M(H_j)}\right]^\lambda \equiv \Gamma_1(H_j;\lambda) \tag{3.1.14}$$

$$H_j = \left[\frac{e(H_j)}{s(H_j)}\right]^\lambda - 1 \equiv \Gamma_2(H_j;\lambda) \tag{3.1.15}$$

These equations are the same as (3.1.11) and (3.1.12). It is evident from (3.1.15) that $\partial\Gamma_2/\partial\lambda > 0$ as $e > s$. We have

$$\frac{\partial\Gamma_1}{\partial\lambda} = \left(\frac{e}{s}\right)^\lambda \ln\left(\frac{e}{s}\right) - \left(\frac{e}{M}\right)^\lambda \ln\left(\frac{e}{M}\right) = \left(\frac{e}{s}\right)^\lambda \left[\ln\left(\frac{e}{s}\right) - \left(\frac{s}{M}\right)^\lambda \ln\left(\frac{e}{M}\right)\right] > 0,$$

irrespective of $M \gtreqless e$, since $s < M$. Thus, (a) both Γ_1 and Γ_2 increase with λ; (b) obviously, equilibrium H_j under migration (H_1^*) increases in Γ_1 and equilibrium H_j under no migration (H_2^*) increases in Γ_2 by (3.1.14) and (3.1.15) respectively. Together, (a) and (b) imply that

$$\frac{dH_1^*}{d\lambda} > 0 \quad ; \quad \frac{dH_2^*}{d\lambda} > 0 \tag{3.1.16}$$

In turn, (3.1.16) implies that $dv/d\lambda < 0$. From (3.1.4) it follows that s increases. Hence the number of unskilled individuals, $F(\underset{+}{s}, \underset{+}{\lambda})$, rises. Summarizing,

Proposition 3.1.1. *Whether or not migration takes place, an increase in inequality leads to (i) an increase in the number of unskilled workers and hence a decrease in the number of individuals who receive education, (ii) an increase in the ratio of skilled laborer working domestically to entrepreneurs and (iii) a decline in the skilled wage.*

Intuitively, given a Pareto distribution, an increase in the inequality parameter λ implies a more skewed distribution of wealth and hence *proportionately* less number of high-wealth individuals and higher number of middle and low-wealth individuals or unskilled workers. Because high-wealth individuals are the entrepreneurs, there is an increase in the skilled laborer employed per entrepreneur. This implies a lower marginal product of skilled laborer and hence a lower skilled wage. Since the distribution of wealth is more skewed and the skilled wage is lower, more individuals decide to remain unskilled.

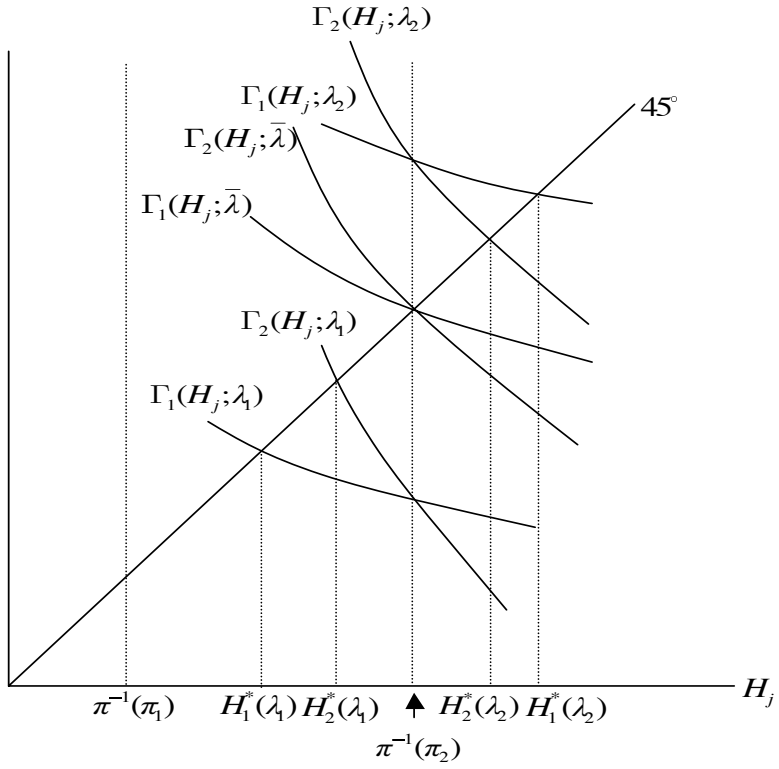

Figure 3.1: Determination of equilibrium skilled labor-entrepreneur ratio

We are now in a position to characterize whether migration occurs or not. Figure 3.1 depicts the functions $\Gamma_1(H_j;\lambda)$ and $\Gamma_2(H_j;\lambda)$ for different value of λ and shows the equilibrium solution. It is already argued that both curves are downward sloping. Further, notice from (3.1.11) and (3.1.12) that $\Gamma_1(H_j;\lambda) \gtreqless \Gamma_2(H_j;\lambda)$ as $M \gtreqless e$, and, as noted earlier, $M \gtreqless e$ as $H_j \gtreqless \pi^{-1}(\pi_2)$. Thus $\Gamma_1(H_j;\lambda) \gtreqless \Gamma_2(H_j;\lambda)$ as $H_j \gtreqless \pi^{-1}(\pi_2)$. This

explains the relative slopes of the two functions and their intersection at $H_j = \pi^{-1}(\pi_2)$ irrespective of the value of λ.

Since $\partial\Gamma_1/\partial\lambda$ and $\partial\Gamma_2/\partial\lambda$ are both positive, it follows that both curves shift up as λ increases. In Figure 3.1, $\lambda_2 > \bar{\lambda} > \lambda_1$, where $\bar{\lambda}$ is such that the two curves intersect on the 45° line. Thus the relation

$$\pi^{-1}(\pi_2) = \Gamma_2(\pi^{-1}(\pi_2), \bar{\lambda}),$$

defines $\bar{\lambda}$, *i.e.*,

$$\bar{\lambda} = \frac{\ln[1 + \pi^{-1}(\pi_2)]}{\ln e[\pi^{-1}(\pi_2)] - \ln s[\pi^{-1}(\pi_2)]}. \tag{3.1.17}$$

Notice that for $\lambda = \lambda_1$, $H_1^*(\lambda_1) < H_2^*(\lambda_1) < \pi^{-1}(\pi_2)$. But $H_2^*(\lambda_1)$ cannot be the equilibrium solution, since no migration occurs only when $H_j > \pi^{-1}(\pi_2)$. Hence $H_1^*(\lambda_1)$ is the unique equilibrium solution. Now, we know that $H_1^*(\lambda) \geq \pi^{-1}(\pi_1)$ must hold for all λ otherwise the incentive compatibility constraint for entrepreneurship (3.1.10) will be violated. Let us define $\hat{\lambda}$ such that $H_1^*(\hat{\lambda}) = \pi^{-1}(\pi_1)$. Clearly, $\hat{\lambda} < \bar{\lambda}$. Then for all economies with $\lambda < \hat{\lambda}$ the curve plotting $\Gamma_1(H_j; \lambda)$ will always intersect the 45° line at $H_j = \pi^{-1}(\pi_1)$ and will have the unique equilibrium at $H_1^*(\lambda) = \pi^{-1}(\pi_1)$.[15] For $\lambda = \lambda_2$, we see that $\pi^{-1}(\pi_2) < H_2^*(\lambda_2) < H_1^*(\lambda_2)$. Since migration occurs only when $H_j < \pi^{-1}(\pi_2)$, $H_1^*(\lambda_2)$ cannot be the equilibrium solution; $H_2^*(\lambda_2)$ is the unique equilibrium solution. Thus,

Proposition 3.1.2. *There will be no migration or positive migration accordingly as* $\lambda \gtrless \bar{\lambda}$*, where* $\bar{\lambda}$ *is defined in (3.1.17).*

[15] Suppose for any $\lambda < \hat{\lambda}$ the curve plotting $\Gamma_1(H_j; \lambda)$ intersects the 45° line at $H_j(\lambda) < \pi^{-1}(\pi_1)$. This can never be an equilibrium since people with perfect foresight will soon find that the incentive compatibility constraint for entrepreneurship (3.1.10) is violated and no one will be interested in becoming an entrepreneur. In turn, this will raise the returns to entrepreneurship to the extent that (3.1.10) is just satisfied *i.e.*, an equilibrium will be established at $H_1^*(\lambda) = \pi^{-1}(\pi_1)$ when $\lambda < \hat{\lambda}$.

In this model, an increase in inequality, via an increase in λ, has four effects on migration. First, ceteris paribus, a more skewed distribution of wealth implies less people acquiring education because of the fixed cost of education. This reduces the size of the potential pool who can migrate and hence has a negative effect on migration. Second, as skilled wage declines, it also induces less people to attain education, further reducing the pool of potential migrants. Third, a less skilled wage implies higher profits from being an entrepreneur, and, this tilts the decision against migrating among those who are skilled. Fourth, a lower skilled wage, by itself, tends to encourage migration. However, the last effect only partially offsets the first three for a highly unequal economy. The net effect on skilled labor migration is negative.

3.1.2 Policy implication

Output of skilled sector: nAH_j^{γ}

where n: number of entrepreneurs and by Pareto distribution $n = (\frac{m}{e})^{\lambda}$ where 'e' is defined by (3.1.8).

We know the equilibrium skilled-entrepreneur ratio under migration is determined by (3.1.14) where 'M' is defined by (3.1.6) and 's' by (3.1.4). Note that as migration is obstructed by increasing migration fee ρ by some migration-tax T, M increases implying a rise in the right-hand-side of (3.1.14) for any λ and hence equilibrium H_j increases. Thus, for any inequality, output of the skilled sector increases by a migration-tax since equilibrium H_j increases and n increases as e falls by $v'(H_j) < 0$ and $\pi'(H_j) > 0$. Therefore, maximum output is reached by a tax that makes $e = M$. This solves for the increased migration fee as:

$$\rho + T = \frac{v_f}{1+i} + (g - h) - \pi(H_j^*) \tag{3.1.18}$$

Remark 3.1.1. *Migration-tax T that maximises skilled sector output is lesser for higher inequality level since H_j^* is higher for higher inequality λ.*

The intuition is as follows. A migration-tax not only creates disincentive to migrate but acts as a substitute of entrepreneurial subsidy. We have seen that higher the inequality the higher is equilibrium profit that acts as a disincentive for migration as well. Thus the necessity for migration-tax to increase skilled sector output via a disincentive to skilled migration is lesser in more unequal economies.

3.2 Variable unskilled wage: Pattern of skilled-unskilled labor migration

We have so far assumed that (a) the home production sector needs only unskilled workers and they are paid an unskilled wage exogenously determined by technology and (b) unskilled workers cannot migrate. We now relax these assumptions.

Suppose that a home production sector needs land as an additional factor. Let the production function be $Y = P(L, N)$, where $P(\cdot)$ is linearly homogeneous, L is the number of unskilled laborers and N denotes land. Land supply is fixed at $\bar{N}$. Then

$$Y = P(L, \bar{N}) \equiv G(L); \quad G_L > 0 > G_{LL},$$

i.e., unskilled labor is subject to diminishing returns.

In autarky, the unskilled wage is determined by its marginal product, *i.e.* $w = G_L(L)$. We have discussed the determination of H_j at a given w. Once we know H_j, v is obtained from (3.1.1). Using this, from (3.1.4) we obtain s, the threshold value of inheritance

below which everyone remains unskilled, as a function of w. Hence $L = F(s(w))$ and thus the unskilled wage is the solution to:

$$w = G_L(F(s(w))). \tag{3.2.1}$$

An increase in w leads to an increase in s by (3.1.4), implying a rise in $F(s)$. With $G_{LL}(L) < 0$, $G_L(F(s(w)))$ falls as $F(s(w))$ rises. Hence the right-hand side decreases with w and thus (3.2.1) yields unique solution of w, w^*.

Let w_f denote the foreign unskilled wage, which is exogenous. Clearly, if the autarky w is less than w_f, some of the unskilled people will migrate and the unskilled wage will rise till it becomes equal to w_f. Suppose that the distribution of wealth is also Pareto as before. Then the extent of unskilled labor migration will depend upon λ too.

At any given w, an increase in λ implies an increase in $F(\cdot)$. This tends to reduce G_L, implying intuitively that $dw/d\lambda < 0$. Thus:

Proposition 3.2.1. *Define λ_u such that $w^*(\lambda_u) = w_f$. Unskilled labor migration occurs if $\lambda > \lambda_u$.*

Note that λ_u depends on foreign skilled wage as well, since s is dependent on v_f. Now consider $\bar{\lambda}$, the critical level of inequality in relation to skilled labor migration. It is a function of w_f to the extent that s depends on w_f. Thus, similar to λ_u, $\bar{\lambda}$ is a function of both w_f and v_f. However, $\bar{\lambda}$ and λ_u are not generally comparable. Their magnitudes depend, among other parameters, on the technology parameters in the two sectors, which are not comparable. Accordingly, two cases arise: (i) $\bar{\lambda} < \lambda_u$ and (ii) $\bar{\lambda} > \lambda_u$ (ignoring the razor-edge case $\bar{\lambda} = \lambda_u$). Comparing Propositions 3.1.2 and 3.2.1 yields

Proposition 3.2.2. *Only unskilled labor migration will take place from a highly unequal economy defined by* $\lambda > \max(\bar{\lambda}(w_f), \lambda_u)$ *and only skilled labor migration will occur from a highly equal economy defined by* $\lambda < \min(\bar{\lambda}(w_f), \lambda_u)$. *For economies with* λ *in between* $\bar{\lambda}$ *and* λ_u, *no migration occurs or both types of migration occur according as* $\bar{\lambda} \lessgtr \lambda_u$.

This is illustrated in Figure 3.2, which is directly based on Propositions 3.1.2 and 3.2.1.

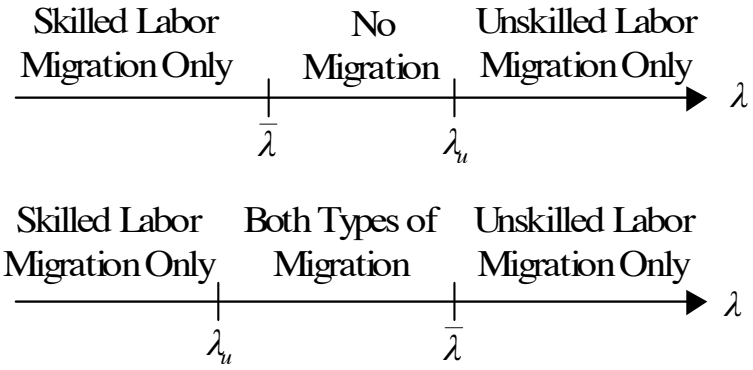

Figure 3.2: Inequality and pattern of migration

3.3 Conclusion

The chapter relates inequality of an economy with the migration incentives of its agents by a model of occupational choice. We assume that capital market is imperfect and there are indivisible costs of acquiring education, migration and for being an entrepreneur. Agents decide their investment strategies related to occupational choice, depending upon the reward from the respective occupation as well as their inheritances. Relative to the existing theoretical literature on migration, the most distinguishing feature of our model is the allowance of entrepreneurship as an occupational choice, which implies that the incentive to migrate is not affected solely by the wage differentials across countries.

Given that the cost of education is lower than that for becoming an entrepreneur and assuming wealth follows Pareto distribution, the chapter obtains that a highly unequal (equal) economy sustains unskilled (skilled) labor migration only. This is consistent with the empirical observation that relatively large migration of unskilled (skilled) labor do occur from developing economies which are relatively unequal (equal).

3.4 Appendix

Appendix 3.1: Proof of Lemma 3.1.1

Consider various ranges within which H_j^* can lie in equilibrium. Suppose $H_j^* \in [H_j(\pi_1), H_j(\pi_2)]$. Then $\pi(H_j^*) \in [\pi_1, \pi_2]$. Here, $e \geq M$. If $e = M$ (in the case, $\pi(H_j^*) = \pi_2$), then $e \leq \rho + h$. It is because (3.1.7) must hold as a necessary incentive for migration. Therefore, using (3.1.7) and (3.1.8), one can easily show that $e \leq (\rho + h)$. Now, from (3.1.9), it is clear that, in this case, people with $x \in [e, \rho + h]$ will be indifferent between migrating and investing as an entrepreneur. Obviously, people with $x > \rho + h$ will get strictly higher utility from entrepreneurship. If $e > M$ (in the case, $\pi(H_j^*) < \pi_2$), people with $M \leq x < e$ migrate and people with $x \geq e$ become entrepreneurs. Therefore, this is the case when there is migration.

If $H_j(\pi_1) < H_j(\pi_2) < H_j^*$, then $\pi_1 < \pi_2 < \pi(H_j^*)$. Here, $e < M$. Therefore, everyone with $x \geq e$ prefers to become an entrepreneur rather than migrate and there is no migration.

Chapter 4

Rise in Wage Inequality: Role of Technology and Outsourcing

Introduction[1]

Casual as well as rigorous empirical investigations show that in the recent phase of globalization there has been a substantial rise in skilled-unskilled wage gap in both developed and developing countries. This rise in wage inequality being a great concern, economists have made several attempts to provide ex-post justifications to this phenomenon. While, for the developed countries, who export mostly skilled intensive commodities, simple trade theory can explain such a rise in wage inequality as an impact of opening up of economies but such theories contradict the rise in wage inequality in the developing countries that primarily export unskilled labor intensive commodities. The basis for such an observation relate mainly to technology bias towards skilled labor (Lawrence and Slaughter (1993)), increased trade (Leamer (1993); Leamer (1995); Leamer (2000); Borjas and Ramey (1995); Robbins (1995); Feenstra and Hanson (1996); Wood (1997)) or, outsourcing activities of northern firms to South, with cheaper labor cost as well as large market for their products in South. For example, Feenstra and Hanson (1999) attribute 15% of the rise in wage gap in US to outsourcing by US MNFs. Feenstra and

[1]**This chapter is based on Roy Chowdhury (2010).**

Hanson (1997) show that growth in FDI is positively correlated with a rise in relative demand of skilled labor, which is consistent with the hypothesis that outsourcing by the multinationals has been a significant factor in the rise in demand for skilled labor in Mexico. In another paper by Feenstra and Hanson (1995) a factor endowment model has been presented where one good is produced by continuum of goods ranked with skill intensity. North outsources relatively unskilled intensive products to South, where these are relatively skilled intensive. Thus an inflow of northern capital in South causes a rise in the relative demand for skilled labor in both the countries. Their paper could explain the fall in the relative demand for unskilled labor hence the relative fall in unskilled wage in US during 1980s.

Gao (2002) presents a two-country model where outsourcing and skilled-unskilled wage are endogenously determined and shows that globalization, in terms of reduction in trade costs, leads to a rise in both outsourcing and skilled-unskilled wage in both the countries. Beaulieu et al. (2004) also argue, a reduction in trade barrier in hi-tech sectors might lead to such a rise in wage gap in both developed and developing countries.

Glazer and Ranjan (2003) provide another interesting explanation. In a two-country framework, if skilled people consume relatively skilled intensive goods compared to the unskilled people, an increase in supply of skilled labor in either country might result in an increase in demand for skilled labor and raise skilled-unskilled wage gap in both countries.

In contrast to the above papers that explain the simultaneous rise in wage-gaps in both North and South either by trade or by technology, the present chapter builds up a simple model of outsourcing and shows that neither technology nor trade alone but

both taken together are responsible for this recently observed and empirically tested phenomenon. The conclusion is very similar to that of Zeira (2007) who shows that trade liberalization increases the wage gap in developed countries, but reduces it in less developed countries. Since in recent decades an increase in the wage gap in less developed countries is also observed, Zeira (2007) concludes that it cannot be the result of trade liberalization only and one needs to add the effect of skill-biased technical progress, which according to his model increases the wage gap both in developed and in less developed countries. Thus he emphasizes that the widening of the wage gap between skilled and unskilled workers cannot be attributed to any one factor, neither to trade liberalization nor to skill-biased technical progress. In fact, Zeira (2007) shows the role of trade liberalization has been rather small. The changes in both the technology and trade are exogenous in his explanation, which is in contrast to the present framework where an exogenous technological change raises the wage gap in North and then raises it in South via an endogenous change in trade or outsourcing. Moreover, Zeira (2007) does not take into account outsourcing.

Outsourcing being a very recent phenomenon, so far it has hardly been explored theoretically. A small number of papers on outsourcing exist in the trade literature but in different contexts. For example, Feenstra and Hanson (1996); Egger and Falkinger (2006); Grossman and Helpman (2004); Glass and Saggi (2001); Chen et al. (2004); Zhao (2001). This chapter deviates from these theoretical models of outsourcing by formally modelling outsourcing in a two-country occupational choice framework where the macro outcomes of the globally integrated economy are based on the micro level decisions of each economic agent. Outsourcing activity of the northern firms to South is endogenous in the model. Economic agents in each of the countries have to incur an indivisible education cost for becoming skilled and a fixed set up cost has to be incurred to become entrepreneur. Within each economy people decide over their occupational choice

depending upon the inheritance and returns from the occupations. Entrepreneurs in North take the outsourcing decision in addition. The model is based on the assumption of capital market imperfection that plays a crucial role in strengthening the role of wealth inequality in occupational choice.[2]

Given this set up, any technological upgradation in North increases the skilled wage in North via an increase in the productivity of skilled workers there, which is quite obvious. The skilled wage of the southern laborers working in the outsourcing firms also increases for similar reason. This induces the skilled laborers working in the domestic skilled sector of South to move to the outsourcing firms till the domestic skilled wage catches up with the skilled wage offered by the outsourcing firms. Therefore, given the assumption of a fixed and exogenous unskilled wage, the skilled-unskilled wage gap increases in South purely because of outsourcing or trade reason whereas the increase in the same in North is due to the technological improvement. Thus, it is neither technology nor trade alone but *both* together have resulted in such a rise in skilled-unskilled wage gap in North and South. The chapter also investigates some of the major economic impacts of a technological improvement in North on the southern economy. For example, the condition for a fall in the aggregate income of the southern economic agents and that of a shrinking domestic skilled sector in South relative to the entire southern skilled sector (including the outsourcing firms) are obtained.

The present chapter is organized as follows. In Section 4.1 the model economy is presented. The outsourcing equilibrium is explained in Section 4.1.1. The explanation for the rise in wage gaps in North and South and the change in the outsourcing equilibrium as a result of a technological improvement in North are provided in Section 4.2. Some major economic impacts of the technological improvement in North on the southern

[2]The assumption of capital market imperfection is widely used in the literature of economic development, for example, Galor and Zeira (1993); Banerjee and Newman (1993).

economy are discussed in Section 4.2.1. Section 4.3 provides the concluding remarks. The Appendix in Section 4.4 contains derivations of few results given in the main text.

4.1 The basic model

The model utilizes a two-period overlapping generations (OLG) framework. There are two countries, North and South. The northern entrepreneurs can outsource skilled jobs to South.

Each country faces a fixed interest rate due to international mobility of capital. But the credit market is imperfect with a gap between the lending and borrowing rates.

There is only one good in each country. It can be produced in two sectors: one with only unskilled laborer (home production type) and the other in which entrepreneurs employ skilled workers. Full employment prevails in both the labor markets.

There are infinitely many altruistic people in each country, with population normalized to unity. An agent's choice with respect to occupational investment and employment in each country is as follows. In the first period of his life, an agent receives an inheritance and decides his occupational choice. If he decides neither to undertake education nor become an entrepreneur, he invests his wealth in the capital market and works as unskilled in the first period. Otherwise, he may choose to invest in education and work as skilled laborer or invest in the set up cost and become an entrepreneur. To make any of the above investment decisions, he may borrow from the capital market if he does not have adequate wealth. In case he has adequate wealth, he makes the desired investment and lends the rest of his inheritance to the capital market. In the second period of his life, each individual earns according to the investment made in first period

(unskilled people continue to work as unskilled laborers in the second period), consume, and leave a bequest. In this period, people in North who have invested in the set up cost to become entrepreneurs choose whether to outsource jobs in South or to produce in their own country.

Let us define North as foreign economy, 'f', and South as domestic economy, 'd'.

Technologies

The home production sector uses unskilled laborer under a linear technology,

$$Y = wL$$

where L denotes unskilled laborer and w is unskilled wage.

In the other sector, an entrepreneur, j, in each country hires skilled laborer and faces the production function:

$$Y_j = A_k H_j^{\gamma}; \quad 0 < \gamma < 1 < A_k \quad \forall k = f, d.$$

where A_k is the technology parameter of the firms in country $k(k = f, d)$ and H_j is the skilled laborers employed by 'j' in a particular economy. By the full employment assumption, H_j is actually the ratio of total number of skilled people that work in the skilled sector to the total number of entrepreneurs of the economy.

Diminishing returns to scale implies the presence of some fixed factor, which can be interpreted as fixed entrepreneurial effort. Notice the distinguishing feature of this two-sector model that unskilled and skilled laborers are not directly substitutable in production, while skilled labor and entrepreneurial efforts are.

For each of the economies, let v be a general notation to skilled wage and the profit of an entrepreneur is $\pi_j = Y_j - H_j v$. The profit-maximizing level of the skilled labor employment in country 'k' is determined by

$$v = A_k \gamma H_j^{\gamma-1} \tag{4.1.1}$$

Assuming that entrepreneurial efforts in 'k' are same across all entrepreneurs,

$$\pi_j = A_k(1-\gamma)H_j^{\gamma} \quad \forall j \tag{4.1.2}$$

For each country eqs. (4.1.1) and (4.1.2) respectively define

$$v = v(H_j) \quad ; \quad \pi = \pi(H_j) \tag{4.1.3}$$

Once H_j is determined for each country, v and π are known via these functions.

Preferences and occupational choice

The utility function of the agents in each country is defined over consumption, c, and the bequest, b: $U = c^{\delta} b^{1-\delta}$, where $0 < \delta < 1$. In period 2, this is maximized subject to, $b + c \leq Z$, where Z denotes net-wealth in period 2. Z equals:

$(x+w)(1+r)+w;$	if doesn't invest in education or as entrepreneur	(i)
$(x-h)(1+i)+v;$	if invests in education and is borrower	(ii)
$(x-h)(1+r)+v;$	if invests in education and is lender	(iii)
$(x-g)(1+i)+\pi;$	if invests in set up cost and is borrower	(iv)
$(x-g)(1+r)+\pi;$	if invests in set up cost and is lender	(v)

where x is the inheritance, h is indivisible education cost and g is indivisible set up cost of entrepreneurs with $g > h$.[3]

[3]There are papers that support and empirically justify that entrepreneurs are from the richer section of the wealth distribution. Evans and Jovanovic (1989) were among the first to find the determinants of entrepreneurship focusing in particular the effects of receiving large bequests on the probability of becoming entrepreneurs. Subsequent studies (for example, Hamilton (2000)) also find similar effects of large positive income shocks on entrepreneurship.

The borrowing rate, i, exceeds the lending rate, r. This is the source of capital market imperfection in the model.[4] Furthermore, we assume $w \geq w_{min}$.[5] Since the home production sector uses a linear technology and w is a constant in the model this assumption does not play any crucial role.

As the indirect utility function is increasing in Z, in period 1, the objective is to maximize Z, or net-wealth. A person decides to invest in education if his net-wealth by investing in education does not fall short of that he would receive if he remains unskilled. Let s denote the threshold inheritance above which a person decides to invest in education. By comparing (i) and (ii) we get s for $x < h$ as,

$$s = \frac{w(2+r) + h(1+i) - v}{i - r} \tag{4.1.4}$$

In view of the function $v(H_j)$, s is a function of H_j, $s(H_j)$. We have $s' > 0$ as $v'(H_j) < 0$; this is intuitive.

The skilled-unskilled wage differential must be high enough, so that those who can self-finance education do prefer this choice for remaining unskilled. This amounts to comparing (i) and (iii), which yields

$$v \geq [w(2+r) + h(1+r)] \qquad \text{for} \quad x \geq h \tag{4.1.5}$$

Given that the marginal product of skilled laborer approaches ∞ as H_j tends to zero, this condition must hold in equilibrium.

Comparing (iii) to (iv) yields the level of threshold inheritance for the entrepreneurial

[4] This difference might be due to the cost the lender bears to keep track of the borrower, as assumed by Galor and Zeira (1993).

[5] $w_{min} = \frac{1}{(2+r)} \left[\frac{g(1+i) - h(1+r)}{(\frac{1-\gamma}{\gamma} - 1)} - h(2+i) \right]$, defined in Appendix 4.1.

choice:[6]

$$e = \frac{v - h(1+r) + g(1+i) - \pi}{i - r} \tag{4.1.6}$$

Note that e is a function of H_j, $e = e(H_j)$, and $e' < 0$.

An individual with $x \geq g$ invests in the set up cost if his net-wealth from entrepreneurship does not fall short of that he would receive if he invests in education:

$$\pi \geq v + (g - h)(1 + r) \tag{4.1.7}$$

which is obtained by comparing (iii) and (v).

At equilibrium in each of the economies, (4.1.7) will be satisfied, otherwise, there will be no entrepreneur which implies $H_j \to \infty$ hence $\pi \to \infty$ by (4.1.2) and then (4.1.7) will automatically get satisfied.

Now, let v^f denote the skilled wage offered by foreign (northern) firms in South and π^f, the profit earned by them in South. Let $\tilde{\pi}$ denote the profit earned by firms operating in North and $\tilde{v}$, the skilled wage in North. Suppose, v^d is the skilled wage offered by domestic (southern) firms in South.

In equilibrium the skilled wage offered by the outsourcing firms in South, v^f, equals the skilled wage offered by the domestic firms, v^d, by the movement of the southern laborers between the domestic and the foreign skilled sector in South. Thus, putting the values of v^f and v^d from (4.1.1) in $v^f = v^d$ and rearranging terms we get the 'skilled labor market equilibrium' condition of South as:

$$H_{jf} = \left(\frac{A_f}{A_d}\right)^{\frac{1}{1-\gamma}} H_{jd} \tag{4.1.8}$$

[6]We do not consider the incentive compatibility constraint of entrepreneurship for people with $x < h$ because, if it is satisfied, there will be no skilled worker, which can never be equilibrium.

where H_{jf} is the number of skilled people employed by each of the outsourcing firms in South and H_{jd} is the number of skilled people employed by the domestic entrepreneurs.

The profit of the northern firms that outsource jobs in South and the northern firms producing in North must be equalized in equilibrium otherwise, more and more northern firms would outsource jobs in South till the profits are equalized. Thus, putting the values of π^f and $\tilde{\pi}$ from (4.1.2) in $\pi^f = \tilde{\pi}$ and rearranging terms we get the 'outsourcing equilibrium' as:

$$H_{jf} = \tilde{H}_{jf} \tag{4.1.9}$$

where $\tilde{H}_{jf}$ is the number of skilled people employed by each of the northern firms or the skilled labor-entrepreneur ratio in North.

We find that once we determine H_{jf} and H_{jd} we can determine all the endogenous variables hence the occupational pattern of both the economies. Now let us see how equilibrium outsourcing and equilibrium skilled labor-entrepreneur ratio in each of the economies are determined.

4.1.1 Outsourcing equilibrium

We denote the cumulative distribution of wealth in South by $F(\cdot)$. Thus the number of entrepreneurs in the domestic economy (South) has the expression $[1 - F(e(H_{jd}))]$ since all the endogenous variables in South depend on H_{jd}. The number of skilled laborers working in the southern economy is equal to $[F(e(H_{jd})) - F(s(H_{jd}))]$. Suppose the number of northern firms outsourcing in South is ε. Then among the skilled people of South, εH_{jf} work under foreign firms. Therefore, the total number of skilled laborers employed by the domestic entrepreneurs is, $[F(e(H_{jd})) - F(s(H_{jd})) - \varepsilon H_{jf}]$. Putting the value of H_{jf} from (4.1.8) and rearranging terms we find,

$$H_{jd} = \frac{[F(e(H_{jd})) - F(s(H_{jd}))]}{[1 - F(e(H_{jd})) + \left(\frac{A_f}{A_d}\right)^{\frac{1}{1-\gamma}} E]} \tag{4.1.10}$$

We solve this equation for H_{jd} as a function of E, $H^*_{jd}(E)$. Note that the right-hand-side expression of (4.1.10) is a decreasing function of H_{jd}, given E, while the left-hand-side expression (obviously) is increasing.[7] Thus, $H^*_{jd}(E)$ is unique for any E.

Suppose the cumulative density function of wealth for the northern economy is $\tilde{F}(\cdot)$. The number of entrepreneurs in North has the expression $[1 - F(e(\tilde{H}_{jf}))]$. The number of skilled laborers working in the northern economy is equal to $[\tilde{F}(e(\tilde{H}_{jf})) - \tilde{F}(s(\tilde{H}_{jf}))]$. We know that '$E$' number of entrepreneurs of North move to South to outsource jobs. Therefore, the number of entrepreneurs producing in the northern economy is $[1 - \tilde{F}(e(\tilde{H}_{jf})) - E]$. Putting $H_{jf} = \tilde{H}_{jf}$ by (4.1.9) we get

$$H_{jf} = \frac{[\tilde{F}(e(H_{jf})) - \tilde{F}(s(H_{jf}))]}{[1 - \tilde{F}(e(H_{jf})) - E]} \tag{4.1.11}$$

We solve this equation for H_{jf} for any E, $H^*_{jf}(E)$. The right-hand-side expression of (4.1.11) is also a decreasing function of H_{jf}, while the left-hand-side expression is increasing. Thus, for any E, $H^*_{jf}(E)$ that solves (4.1.11) is unique too.

For further characterization, we assume a Pareto distribution of wealth, a very standard form of distribution used in the literature, whose density function is given by

$$f(x) = \frac{\lambda m^\lambda}{x^{\lambda+1}}; \quad x \geq m > 0, \lambda > 0$$

where λ is the Pareto inequality parameter. The higher the value of λ, the greater is the number of people concentrated at the lower wealth levels, hence the higher is the degree

[7] Since, $e(H_{jd})$ is decreasing in H_{jd} by (4.1.6), (4.1.1) and (4.1.2) and $s(H_{jd})$ is increasing in it by (4.1.4) and (4.1.1).

of inequality. The cumulative density function has the expression:

$$F(x) = \int_m^x \frac{\lambda m^\lambda}{X^{\lambda+1}} dX = 1 - \left(\frac{m}{x}\right)^\lambda \tag{4.1.12}$$

Suppose λ is the inequality parameter of wealth distribution for South and $\tilde{\lambda}$ is the inequality parameter of wealth distribution for North. Using a Pareto distribution in (4.1.10) and (4.1.11), H^*_{jd} and H^*_{jf} are determined respectively by:

$$H_{jd} = \frac{[\left(\frac{m}{s}\right)^\lambda - \left(\frac{m}{e}\right)^\lambda]}{[\left(\frac{m}{e}\right)^\lambda + \left(\frac{A_f}{A_d}\right)^{\frac{1}{1-\gamma}} E]} \equiv \Gamma_1(H_{jd}; \lambda) \tag{4.1.13}$$

$$H_{jf} = \frac{[\left(\frac{m}{s}\right)^{\tilde{\lambda}} - \left(\frac{m}{e}\right)^{\tilde{\lambda}}]}{[\left(\frac{m}{e}\right)^{\tilde{\lambda}} - E]} \equiv \Gamma_2(H_{jf}; \tilde{\lambda}) \tag{4.1.14}$$

These equations are the same as (4.1.10) and (4.1.11).

It is evident from (4.1.13) that $\partial\Gamma_1/\partial E < 0$ and from (4.1.14) $\partial\Gamma_2/\partial E > 0$. Thus, Γ_1 decreases and Γ_2 increases in E. Now, from (4.1.13) that determines equilibrium H_{jd}, it is obvious that H^*_{jd} falls as Γ_1 decreases and from (4.1.14) (that determines equilibrium H_{jf}) we know H^*_{jf} rises as Γ_2 increases. These together imply,

$$\frac{dH^*_{jd}}{dE} < 0; \quad \frac{dH^*_{jf}}{dE} > 0 \tag{4.1.15}$$

Putting $H^*_{jd}(E)$ and $H^*_{jf}(E)$, obtained from (4.1.13) and (4.1.14) respectively, in (4.1.8) and rearranging we get

$$\left(\frac{A_d}{A_f}\right)^{\frac{1}{1-\gamma}} H^*_{jf}(E) \;\; = \;\; H^*_{jd}(E) \tag{4.1.16}$$

Note that by (4.1.15) the left-hand-side of (4.1.16) is increasing in E and the right-hand-side is decreasing in it. Thus (4.1.16) gives a unique solution of equilibrium E, E^*.

Let us illustrate the equilibrium outcome in Figure 4.1. It depicts two functions, the right-hand-side and the left-hand-side of (4.1.16) against E as DD and FF respectively. It is already argued that DD is a downward sloping curve and FF is an upward sloping curve. The point of intersection of DD and FF gives equilibrium E, E^*.

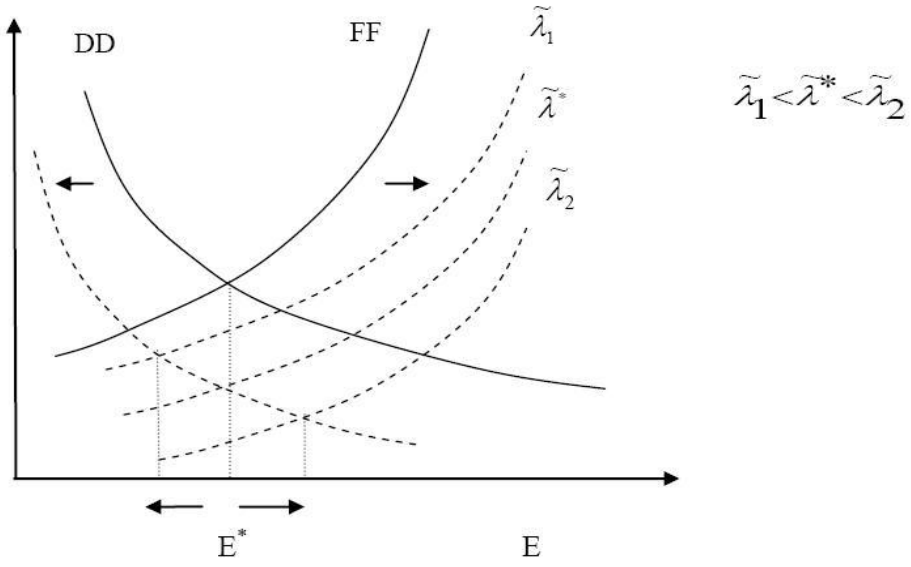

Figure 4.1: Outsourcing equilibrium

Now, we put E^* in $H^*_{jd}(E)$ and $H^*_{jf}(E)$ to obtain equilibrium $H_{jd}, H^*_{jd}(E^*)$, and equilibrium $H_{jf}, H^*_{jf}(E^*)$ respectively. Thus, all the endogenous variables of the model as well as the occupational pattern of the two economies get determined once we obtain $H^*_{jd}(E^*)$ and $H^*_{jf}(E^*)$.

4.2 Technological improvement in North: Effects on wage gaps and outsourcing

Suppose there is a technological improvement in North that makes A_f to rise. From (4.1.13) it is obvious that $\partial\Gamma_1/\partial A_f < 0$. In North, any technological improvement

changes the northern skilled wage and profit of the northern entrepreneurs which in turn change the occupational thresholds in North hence Γ_2. It can be shown that $\partial\Gamma_2/\partial A_f < 0$.[8] For any E, $\partial\Gamma_1/\partial A_f < 0$ and $\partial\Gamma_2/\partial A_f < 0$ together imply

$$\frac{dH^*_{jd}}{dA_f} < 0 \quad ; \quad \frac{dH^*_{jf}}{dA_f} < 0 \tag{4.2.1}$$

Clearly, right-hand-side of (4.1.16) falls and left-hand-side of (4.1.16) also falls since

$$\frac{d\left[\left(\frac{A_d}{A_f}\right)^{\frac{1}{1-\gamma}} H^*_{jf}\right]}{dA_f} < 0 \tag{4.2.2}$$

Thus, we find that with a rise in A_f both the curves DD and FF in Figure 4.1 shift down for all E and we get a new equilibrium E. We find that E^* might rise, fall or remain constant. It is evident from the diagram that in the new equilibrium the right-hand-side of (4.1.16), $H^*_{jd}(E^*)$, and the left-hand-side of (4.1.16), $\left(\frac{A_d}{A_f}\right)^{\frac{1}{1-\gamma}} H^*_{jf}(E^*)$, both fall. In turn these imply, $\frac{dv^{d*}}{dA_f} > 0$ since $v^{d*} = \gamma A_d {H_{jd}}^{*\gamma-1}$ and $\frac{dv^{f*}}{dA_f} > 0$.[9] From this the next proposition follows.

Proposition 4.2.1. *Any technological improvement in the outsourcing country North, results in a rise in the skilled-unskilled wage gap in both the countries.*

With a technological improvement in North, the productivity of skilled workers employed by the northern firms rises. This leads to an increase in the skilled wage offered by all the northern firms including those who outsource jobs in South. This explains the rise in skilled-unskilled wage gap in North. In South the skilled laborers working in the outsourcing firms with this improved technology, now get higher wage. This induces

[8] See Appendix 4.1.

[9] Since (4.2.2) implies a rise in $\left(\frac{A_f}{A_d}\right)^{\frac{1}{1-\gamma}} . \frac{1}{H^*_{jf}}$ hence in $\left(\frac{A_f}{A_d}\right) . \frac{1}{H^{*1-\gamma}_{jf}}$ as A_f rises. Thus $v^{f*} = \gamma A_f . {H_{jf}}^{*\gamma-1}$ rises since γ and A_d are constants.

southern skilled laborers to move to the outsourcing firms from the domestic skilled sector. This in turn reduces the number of skilled laborers in the domestic skilled sector of South resulting in a rise in the domestic skilled wage till it catches up with the skilled wage offered by the outsourcing firms. This explains the rise in skilled-unskilled wage gap in the southern economy.

We have seen that when there is a technological improvement in North equilibrium outsourcing might increase, reduce or remain constant. It depends solely on the extent of change in equilibrium skilled entrepreneur ratio of the two economies, hence in the skilled wages. We are now interested to see how the inequality level of North influences the impact of its technological improvement on outsourcing; since the northern inequality level is a prime determinant of equilibrium skilled labor-entrepreneur ratio of North, that in turn determines the level of outsourcing as we find from (4.1.16), (4.1.13) and (4.1.14). For this, we rearrange the terms in Γ_2 and get:

$$\Gamma_2 \equiv \frac{[\left(\frac{e}{s}\right)^{\tilde{\lambda}} - 1]}{[1 - E\left(\frac{e}{m}\right)^{\tilde{\lambda}}]} \tag{4.2.3}$$

We know that the higher the $\tilde{\lambda}$ is the more unequal is the northern economy. It is obvious that $\partial\Gamma_2/\partial\tilde{\lambda} > 0$ since $e > s > m$. This implies, $|\partial^2\Gamma_2/\partial\tilde{\lambda}\partial A_f| > 0$ *i.e.*, the fall in Γ_2 due to an increase in A_f is more for a higher $\tilde{\lambda}$.[10] Now, we have shown that $\partial\Gamma_2/\partial A_f < 0$ implies a fall in $H^*_{jf}(E)$ for any E. Therefore, due to a rise in A_f, the fall in $H^*_{jf}(E)$ for all E, hence the left-hand-side of (4.1.16), is higher for a higher $\tilde{\lambda}$.

[10]From the proof of $\partial\Gamma_2/\partial A_f < 0$ in Appendix 4.1 we can see that the higher the value of $\tilde{\lambda}$ is, the higher is the fall in $\left(\frac{e}{s}\right)^{\tilde{\lambda}}$ since $\left(\frac{e}{s}\right)$ falls. This implies a higher fall in value of Γ_2 for a higher $\tilde{\lambda}$ due to an increase in A_f *i.e.*, $|\partial^2\Gamma_2/\partial\tilde{\lambda}\partial A_f| > 0$.

This is illustrated in Figure 4.1. Notice that the shift in FF relative to DD determines whether E^* falls, remains constant or rises. More specifically, given the downward shift in DD, it is obvious from the diagram that for a smaller shift in FF, E^* falls and it rises when FF shifts to a great extent. We have seen that the extent of shift in FF, implied by a change in the left-hand-side of (4.1.16), is higher for a higher $\tilde{\lambda}$. Thus, we find that the value of $\tilde{\lambda}$ actually determines how E^* would change and whether at all it would change. We define $\tilde{\lambda}^*$ as the value of $\tilde{\lambda}$ for which E^* does not change as a result of technological improvement in North. Therefore, for all $\tilde{\lambda}$ higher than $\tilde{\lambda}^*$, for example $\tilde{\lambda}_2$ in Figure 4.1, the downward shift in FF is higher and E^* rises. Similarly, for all $\tilde{\lambda}$ lower than $\tilde{\lambda}^*$, as $\tilde{\lambda}_1$ in Figure 4.1, the downward shift in FF is lower and E^* falls. Summarizing,

Proposition 4.2.2. *Equilibrium outsourcing increases (decreases) with a technological upgradation in North if the inequality level of North is high (low) enough.*

Any technological improvement in North has two impacts on the profit of the northern entrepreneurs operating in North. Let us for the moment ignore the impact on outsourcing. Firstly, it increases the labor productivity which has a direct positive impact on entrepreneurial profit in North. Now, such a rise in profit induces more people to become entrepreneurs. From Pareto distribution of wealth we know that the higher the inequality level of an economy the larger is the number of people concentrated at the lower wealth level hence the lower is the number of individuals who can invest in the set up cost and become entrepreneurs. Thus in a more unequal northern economy the *relative* rise in the number of entrepreneurs due to such a technological improvement is higher than that in an equal one. Consequently, the skilled labor-entrepreneur ratio falls to a larger extent for the more unequal economy, as it has been verified mathematically too. Now, such a fall in the skilled labor-entrepreneur ratio has a negative impact on entrepreneurial profit as we find from the expression of profit in (4.1.2). The net impact of such a technological improvement on the profit depends on the relative strength of

the two forces that affect profit. The higher the inequality the higher is the strength of the negative force due to a higher fall in the skilled labor-entrepreneur ratio. Thus, there exists some inequality level $\tilde{\lambda}$ for which the two forces just offset each other. Let us define that $\tilde{\lambda}$ as $\tilde{\lambda}^*$. It is evident that for all $\tilde{\lambda}$ higher (lower) than $\tilde{\lambda}^*$ the positive force will offset the negative one and profit would increase (decrease). Obviously, when the negative impact offsets the positive one profit falls. Then some of the northern entrepreneurs move to South to outsource jobs till at the new outsourcing equilibrium the profit of the northern firms in North increases and becomes equal to the profit level of the northern firms outsourcing jobs in South. Similarly one can explain the fall in equilibrium outsourcing when the positive impact offsets the negative one and the profit rises.

4.2.1 Effects of technological improvement in North on South

We have seen that one of the major impacts of any technological improvement in North on the southern economy is a rise in the skilled unskilled wage inequality in South. Now, one might be interested to study the other economic impacts, particularly the aggregate income of the agents in the southern economy or the effect on the size of the domestic skilled sector. We discuss these issues in the following propositions.

Proposition 4.2.3. *If the northern economy is an equal one such that equilibrium outsourcing falls due to technological improvement in North then the aggregate income of the economic agents of South falls with the sufficient condition* $|\frac{dE}{E}/\frac{dc}{c}| \geq 1$ *where* $c = A_f^{\frac{1}{1-\gamma}}$.

The aggregate income of all the economic agents of South or the national income of South, TI_d, is the total income generated by the southern domestic sectors (the domestic skilled sector and the home production sector) and the outsourcing firms. TI_d is basically the total wages of the unskilled laborer, total wages of the skilled laborers working in the domestic sector as well as in the outsourcing firms and the profits of the domestic

entrepreneurs. Thus,

$$TI_d \;=\; wL + nA_d H_{jd}^{\gamma} + \text{ɛ} H_{jf} v_f$$

where the first term in the expression of TI_d is the total income generated by the home production sector. In this sector entire unskilled labor force of the economy, $L \equiv F(s)$, is engaged where s is defined in (4.1.4) and $F(\cdot)$ is the cumulative distribution of wealth in South. The second term is the total income generated by the domestic skilled sector where n is the number of southern entrepreneurs and their total production or income generated by them is $nA_d H_{jd}^{\gamma}$. This includes the profit of the southern entrepreneurs and the total wages earned by the skilled laborers working in the domestic skilled sector. The last term is the total skilled wages earned by the southern skilled laborers working in the outsourcing firms where H_{jf} is the number of skilled engaged in the outsourcing firms and earning wage v_f. Rearranging terms and simplifying the expression of TI_d we obtain:[11]

$$TI_d \;=\; wL + H_{jd}^{\gamma}\left(nA_d + \frac{\gamma \text{ɛ} C}{A_d{}^{\frac{\gamma}{1-\gamma}}}\right) \tag{4.2.4}$$

We have seen that any technological improvement in North results in a rise in the skilled wage in South. Therefore, in South more people around the threshold wealth level of educational investment, s, invest in education hence L falls and lesser people decide to work as unskilled in the home production sector. Thus the first term of the expression TI_d in (4.2.4) falls. A rise in the southern skilled wage implies a fall in equilibrium H_{jd} by (4.1.1) hence the profit of entrepreneurs in South falls by (4.1.2) leading to a fall in the number of entrepreneurs, n, in equilibrium. It is obvious from (4.2.4) that TI_d falls if '$\text{ɛ} C$' falls or remains constant. The expression of c shows that c increases with a rise

[11] Derived in Appendix 4.2.

in A_f. In Proposition 4.2.2 we have seen that, with a technological upgradation, equilibrium E falls for an equal outsourcing country. Clearly, EC falls (or, remains constant) only if $|\frac{dE}{E}/\frac{dc}{c}| \geq 1$. This proves the proposition.

The intuition is quite clear. Any change in the technology of the northern firms creates a distortion in the southern economy by changing the occupational pattern. Firstly, the productivity of skilled workers increases and the northern firms that outsource jobs to South offer higher skilled wage which induces some of the workers of the domestic skilled sector of South to move to the outsourcing firms. Secondly, due to endogenous occupational choice some of the entrepreneurs in South at the marginal wealth level of entrepreneurship find it worthwhile to work as skilled laborer. This reduces the number of domestic entrepreneurs in South hence the total production of the indigenous entrepreneurs in the domestic skilled sector of South falls. On the other hand, the output of the home production sector gets reduced too since the southern skilled wage rises and some of the individuals at the margin decide to invest as skilled laborer rather than remaining unskilled. Thus the number of unskilled laborers in the home production sector decreases resulting in a fall in the output of that sector too. This explains the decrease in the income of the economic agents in aggregate.

When the northern economy is an unequal one such that equilibrium outsourcing increases as a result of any technological improvement in North, the skilled sector of South expands for obvious reason. It is obvious that the only contribution of the northern outsourcing firms to the southern national income is the wages offered to the skilled laborer they employ. With an increase in the number of outsourcing firms the total wages earned by the skilled laborer working in those firms undoubtedly increases. As we have seen, the number of domestic entrepreneurs falls. Thus, intuitively it is clear that the share of the domestic sector or its contribution to the southern national income falls.

The share of the domestic skilled sector in the total income generated by all the entrepreneurs working in South (both the domestic entrepreneurs of South and the outsourcing firms) is:

$$\alpha = \frac{nA_dH_{jd}^{\gamma}}{(nA_dH_{jd}^{\gamma} + \text{E}H_{jf}v_f)}$$

where the numerator in α is the size of the domestic skilled sector or the total income generated by the domestic entrepreneurs and the denominator is the total income generated by all the entrepreneurs in South including the outsourcing firms. Rearranging terms we get,[12]

$$\alpha = \frac{1}{1 + \frac{E\left(\frac{A_f}{A_d}\right)^{\frac{1}{1-\gamma}}}{n}} \tag{4.2.5}$$

Since the number of southern entrepreneurs, n, falls and the northern economy is an unequal one such that E rises as A_f rises, it is obvious that the term $\left(\frac{E}{n}\right)\left(\frac{A_f}{A_d}\right)^{\frac{1}{1-\gamma}}$ rises resulting in a rise in the denominator of α, hence a fall in α. Thus,

Proposition 4.2.4. *If the inequality of the northern economy is high enough such that equilibrium outsourcing increases after any technological improvement in North, the share of the income generated by the domestic entrepreneurs in the national income of South, generated by all the entrepreneurs of South which includes the domestic entrepreneurs as well as the outsourcing firms, shrinks.*

[12]Derived in Appendix 4.3.

4.3 Conclusion

The recent widening of wage inequality in both North and South has been attributed by some economists to the skill-biased technical-change and by others to increased globalization. The chapter explains this phenomenon with an alternative view using an occupational choice framework where it formally models and endogenously determines outsourcing. The chapter shows that an exogenous technological improvement in North causes a rise in the skilled wage in the northern economy via an increased labor productivity whereas the skilled wage in South rises purely due to the endogenous trading (or outsourcing) effect of the northern firms induced by the technological improvement in North and thus concludes that it is neither trade nor technology alone but the combined effect of *both*. Relative to the existing literature, this is the most distinguishing feature of the chapter.

The chapter also analyzes some of the major economic impacts of the technological improvement on the southern economy. It shows, if the northern economy is sufficiently unequal (equal) equilibrium outsourcing increases (decreases) as a result of a technological improvement in North and then finds the condition for a fall in the aggregate income of the southern economic agents as a result of the technological improvement in North. Lastly, it is shown that for a very unequal outsourcing country, the share of domestic sector (or, income generated by the domestic entrepreneurs) in the total income generated by all the southern entrepreneurs (which includes domestic entrepreneurs as well as the outsourcing firms) shrinks after such a technological improvement in North via a decrease in the number of domestic entrepreneurs.

4.4 Appendix

Appendix 4.1

We will prove that $H_{jf}(E)$ falls for any E with a rise in A_f. We know,

$$e = \frac{v - h(1+r) + g(1+i) - \pi}{i - r}$$

where $v = \gamma A_f H_{jf}^{\gamma-1}$ and $\pi = (1-\gamma) A_f H_{jf}^{\gamma}$.

Let us denote the change in A_f as dA_f and obtain the change in e due to a change in A_f, given H_{jf}, as follows.

$$\begin{aligned} de &= \frac{dv - d\pi}{i - r} = \frac{dA_f \left[\gamma H_{jf}^{\gamma-1} - (1-\gamma) H_{jf}^{\gamma}\right]}{i - r} \\ &= \frac{\frac{dA_f}{A_f}\left[\gamma A_f H_{jf}^{\gamma-1} - (1-\gamma) A_f H_{jf}^{\gamma}\right]}{i - r} = \frac{\frac{dA_f}{A_f}\left[v - \pi\right]}{i - r} < 0 \text{ for } dA_f > 0 \text{ (since } \pi > v) \end{aligned}$$

From the expression of Γ_2 in (4.2.3) we find that, if $\left(\frac{e}{s}\right)$ falls, H_{jf}^{*} falls for all E. Now,

$$\begin{aligned} \left(\frac{e}{s}\right) = \frac{g(1+i) - h(1+r) + v - \pi}{w(2+r) + h(1+i) - v} &= \frac{A + v - \pi}{B - v} \\ \Rightarrow \frac{d\left(\frac{e}{s}\right)}{dA_f} | H_{jf} &= \frac{(B-v)(dv - d\pi) + (A + v - \pi) dv}{(B-v)^2} \\ &= \frac{dv(B + A) + v d\pi - \pi dv - B d\pi}{(B-v)^2} \end{aligned}$$

where $A = [g(1+i) - h(1+r)]$ and $B = [w(2+r) + h(1+i)]$

We find, $dv = dA_f \gamma H_{jf}^{\gamma-1}$; $d\pi = dA_f (1-\gamma) H_{jf}^{\gamma}$

$$\begin{aligned} v d\pi &= (\gamma A_f H_{jf}^{\gamma-1})(dA_f (1-\gamma) H_{jf}^{\gamma}) = A_f dA_f \gamma (1-\gamma) H_{jf}^{2\gamma-1} \\ \pi dv &= ((1-\gamma) A_f H_{jf}^{\gamma})(dA_f \gamma H_{jf}^{\gamma-1}) = A_f dA_f \gamma (1-\gamma) H_{jf}^{2\gamma-1} \\ \Rightarrow v d\pi &= \pi dv \end{aligned}$$

$$\text{Therefore, } \frac{d\left(\frac{e}{s}\right)}{dA_f} | H_{jf} = \frac{dv(B + A) - B d\pi}{(B-v)^2} \leq 0 \text{ if } [dv(B + A) - B d\pi] \leq 0.$$

Now,

$$[dv(B+A) - Bd\pi] \leq 0$$

implies

$$\begin{aligned} (A+B)dA_f\gamma H_{jf}^{\gamma-1} - BdA_f(1-\gamma)H_{jf}^{\gamma} &\leq 0 \\ or, \quad \left(\frac{\gamma}{1-\gamma}\right)\left(\frac{A}{B}+1\right) &\leq H_{jf} \end{aligned}$$

We know that H_{jf} is the number of skilled laborers employed by each entrepreneur in country 'f'. Therefore, $H_{jf} \geq 1$ must hold. If $\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{A}{B}+1\right) \leq 1$, then $H_{jf} \geq \left(\frac{\gamma}{1-\gamma}\right)\left(\frac{A}{B}+1\right)$ will automatically hold. This implies, $\frac{d\left(\frac{e}{s}\right)}{dA_f}|H_{jf} \leq 0$ if $\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{A}{B}+1\right) \leq 1$.

By the assumption $w \geq w_{min}$ we get, $w \geq \frac{1}{(2+r)}\left[\frac{g(1+i)-h(1+r)}{(\frac{1-\gamma}{\gamma}-1)} - h(2+i)\right]$ where $w_{min} = \frac{1}{(2+r)}\left[\frac{g(1+i)-h(1+r)}{(\frac{1-\gamma}{\gamma}-1)} - h(2+i)\right]$. This implies, $\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{g(1+i)-h(1+r)}{w(2+r)+h(1+i)}+1\right) \leq 1$ or, $\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{A}{B}+1\right) \leq 1$. Thus, given the parametric assumptions of the model, we find, $\frac{d\left(\frac{e}{s}\right)}{dA_f}|H_{jf} \leq 0$. Therefore, $H_{jf}^{*}(E)$ falls for all E.

Appendix 4.2: Derivation of TI_d

$$\begin{aligned} TI_d &= wL + nA_dH_{jd}^{\gamma} + EH_{jf}v_f \\ &= wL + nA_dH_{jd}^{\gamma} + \gamma EA_fH_{jf}^{\gamma} && \text{(putting the value of } v_f \text{ from (4.1.1))} \\ &= wL + nA_dH_{jd}^{\gamma} + \gamma EA_f\left(\frac{A_f}{A_d}\right)^{\frac{\gamma}{1-\gamma}}{H_{jd}}^{\gamma} && \text{(substituting } H_{jf} \text{ from (4.1.16))} \\ &= wL + H_{jd}^{\gamma}\left(nA_d + \frac{\gamma EC}{{A_d}^{\frac{\gamma}{1-\gamma}}}\right) \end{aligned}$$

where $c = A_f^{\frac{1}{1-\gamma}}$.

Appendix 4.3: Derivation of α

$$\text{Total income generated by the domestic entrepreneurs} \;=\; nA_d H_{jd}^{\gamma}$$

$$\begin{aligned} & \text{Total income generated in South by the outsourcing firms} \\ = \;& \text{Total wages earned by skilled laborers in outsourcing firms} \\ = \;& {}_E H_{jf} v_f \end{aligned}$$

Therefore,

$$\begin{aligned} \alpha &= \frac{nA_d H_{jd}^{\gamma}}{(nA_d H_{jd}^{\gamma} + {}_E H_{jf} v_f)} \\ &= \frac{nA_d H_{jd}^{\gamma}}{\left[nA_d H_{jd}^{\gamma} + {}_E A_f^{\frac{1}{1-\gamma}} \left(\frac{1}{A_d}\right)^{\frac{\gamma}{1-\gamma}} {H_{jd}}^{\gamma}\right]} \qquad \text{(putting the value of } v_f\text{)} \end{aligned}$$

Rearranging terms we get,

$$\alpha \;=\; \frac{1}{1 + \frac{E\left(\frac{A_f}{A_d}\right)^{\frac{1}{1-\gamma}}}{n}}$$

Chapter 5

Wealth Inequality, Entrepreneurship and Industrialization

Introduction

Globalization has multi-dimensional impacts on economic activities. In the recent decades, the empirically verified fact of rising wage inequality between skilled and unskilled labor in both North and South has been one of such impacts that has become a highly debated issue. Economists do not deny the positive effects of globalization, for example, increasing competitiveness and higher specialization that lead to more efficient production processes thus benefitting the global consumers. However, a closer investigation reveals that the positive or negative impacts have not been uniform all over the world. The wage gap between the white color and blue color jobs has widened more rapidly in Latin America. Relative wages are larger among developing countries in Asia but they are less pronounced than in Latin America which is much more unequal.[1] With these dissimilarities in the impact of globalization on different economies, the focus of research has now shifted to find who the real gainers are and who are the losers of such a global integration across the globe and within an economy as well. Consequently, the policy makers are now concentrating largely on making globalization more 'inclusive'.

[1] "Facing Up to Inequality in Latin America: Economic and Social Progress in Latin America", 1998-1999 Report by Inter-American Development Bank, pp. 31.

The present chapter emphasizes that a more crucial question for an economy is 'how to globalize' rather than 'whether to globalize' and given the characteristic of an economy, it sheds some light on how the gains from globalization can be spread to the lower rung of a society by suitable policy measures. The chapter presents an occupational choice model where agents inherit wealth and then choose between two occupations, entrepreneurship and working as laborer. They have to incur an indivisible set up cost for becoming entrepreneur whereas there is no such initial cost for working as a laborer. People can take loan from capital market but the credit market is imperfect in the sense that the borrowing rate of interest is higher than the lending rate.[2] Thus people with lower initial wealth are credit-constrained and can not invest as entrepreneurs.

On the demand side, there are two goods for consumption, one is the basic good and the other is the industrial/luxury good. Only after meeting a certain minimum level of the basic good consumption ($\bar{X}$) an individual would be inclined to spend on the industrial good. Eswaran and Kotwal (1993) make a similar assumption and provide empirical support for their assumption. Obviously, the richer group of people who have enough wealth left after consuming the basic good can afford to consume the industrial good. The chapter shows that even if the industrial sector exists in a restricted trade regime, when trade is opened up and the global price for the industrial good is very low it may not exist depending upon the inequality level of the economy. This is essentially due to poor incentive to entrepreneurship created by such lower external price. In that case the good will be imported and the gains from globalization will be enjoyed only by the rich class who are the sole consumers of the industrial good. Here the inequality-industrialization under free trade works from supply-side by a production externality

[2]This difference might be due to the cost the lender bears to keep track of the borrower, as assumed by Galor and Zeira (1993).

similar to the 'learning-by-doing' technology of Matsuyama (2002). The more the number of entrepreneurs the higher is the productivity in the industrial sector. This is also similar to the type of externality in Paternostro (1997) that the fixed cost faced by each monopolist is a decreasing function of the number of firms that industrialize, thus resembling the type of externalities conceptualized as learning-by-doing in the process of entry. With an indivisible set up cost for entrepreneurship and an imperfect credit market poor people are credit-constrained. The higher the inequality of an economy is the lower is the concentration of people at the higher wealth end of the wealth distribution. Thus number of credit-constrained people for entrepreneurship is higher implying a lower number of entrepreneurs. Since domestic demand doesn't play much role when trade is opened up this lower supply-side externality leads to lower equilibrium profit (incentive to entrepreneurship) and non-existence of the industrial sector at the extreme. This result is similar to that of Grossman (1984) which shows, free trade increases competitiveness and might lower the return to the entrepreneurial activity thereby causing fewer individuals to choose to become entrepreneurs. But, unlike the present chapter, he does not relate inequality of an economy with entrepreneurship.

In the literature that relates wealth inequality and industrialization, demand-constraint is often believed to be a significant channel through which inequality affects the process of industrialization. Earlier theories of Lewis (1954), Ranis and Fei (1961) mainly highlight the role of farm sector in creating adequate demand or purchasing power in the industrial sector and boost industrialization. Murphy et al. (1989) provide a demand-side story of inequality or income distribution and industrialization and conclude that inequality is an obstruction to the process of industrialization because it restricts the size of the market. For increasing number of industries to break-even sales must be large enough to cover the set up cost. Thus, the necessity of a middle class is the central message of their model. A similar conclusion has been reached by Sarkar (1998) but

in a dynamic framework. Matsuyama (2002) presents another demand-side framework that links inequality and industrialization. His model depicts the development process as a series of industries taking off one after another. As productivity improves in these industries, each consumer good becomes affordable to an increasingly large number of households, which constantly expand the range of goods they consume. This in turn generates larger markets for consumer goods and leads to further improvement in productivity. In order for such two-way causality to generate virtuous cycles of productivity gains and expanding markets, income distribution should be neither too equal nor too unequal. Some income inequality is needed for the economy to take off. With too much inequality, the economy's development stops prematurely. Eswaran and Kotwal (1993) also explain why poverty might be impervious to industrial progress in some countries assuming a hierarchical preference structure (following Engel's law) for the population. Foellmi and Zweimüller (2006) introduce non-homothetic preferences into an innovation-based growth model. High concentration of wealth (inequality) may foster innovation and growth by creating a wealthy class willing to pay high prices for new products but may hinder innovation by preserving a poor majority which could otherwise form mass markets. They show, price effects dominate market-size effects and a redistribution from the poor to the rich may be Pareto-improving for low levels of inequality. While most of the demand-side explanations of the literature on inequality and industrialization conclude that under restricted trade inequality is indeed an obstruction to industrialization. The present chapter provides a supply-side mechanism to show that inequality might obstruct industrialization when trade is opened up.

The chapter suggests some policy measures that might help the industrial sector to exist when mere opening up of trade leads to non-existence of the sector. It shows that if the planner designs a subsidy policy that reduces the set up cost and finances it by taxing the rich it would raise the post-trade net-profit and create sufficient incentive for

the low-wealth people to work as entrepreneurs. However, the rich may lose in utility terms since they are the tax payers. The chapter obtains the condition when such a subsidy scheme along with opening up of trade helps the existence of the sector and makes globalization inclusive while mere opening up of trade in the industrial sector obstructs industrialization. Also the policy of giving entry to foreign firms raises the profit level via a rise in the operating firms in the domestic economy and creates sufficient incentive to start production for some low-wealth individuals who otherwise decide to work as laborers. It raises the overall welfare of economy by a rise in the net-wealth of economic agents. This is in sharp contrast to Grossman (1984) who shows that entry to the foreign enterprises merely crowd out local efforts or the development of an entrepreneurial class and thus impart few, if any, benefits on the LDC economy. The present chapter also analyzes the autarkic equilibrium when both the demand and supply-side play important role. It shows that under restricted trade, the policy of subsidizing entrepreneurs financed by a tax on the rich when poor are credit-constrained to invest as entrepreneurs might not be effective in the sense that it does not improve the utility of the new group of entrepreneurs.

The chapter is organized as follows. Section 5.1 provides the basic model. Section 5.2 analyzes the autarkic equilibrium with some policy implications. In Section 5.3 the equilibrium under international trade is derived and the policy implications related to possibilities of welfare improvement are discussed with a calibration exercise. Section 5.4 provides the concluding remarks. The Appendix in Section 5.5 contains derivations of few results given in the main text.

5.1 The basic model

The model depicts a small open economy with infinitely many altruistic people and population normalized to unity. It is a two-good economy: X, basic good, the *numeraire*, produced under a home production type technology and Y, the luxury/industrial good produced by entrepreneurs. Trade is restricted in the industrial good sector. Full employment prevails in the labor market. By international capital mobility, rate of interest is given from abroad. Credit market is imperfect with a gap between the lending and borrowing rates.

The model utilizes a two-period overlapping generations (OLG) framework. An agent, in the first period of his life, receives the inheritance and decides his occupational choice. If he decides not to become an entrepreneur, he invests his wealth in the capital market and works as unskilled in the first period. Otherwise, he may choose to invest in the set up cost and become an entrepreneur. To make any of the above investment decisions, he may borrow from the capital market if he does not have adequate wealth. In case he has adequate wealth, he makes the desired investment and lends the rest of his inheritance in the capital market. In the second period of his life, each individual earns according to the investment made in first period (unskilled people continue to work as unskilled laborer in the second period), consume, and leave a bequest.

Preferences and investment decisions

The utility function (U) is defined over consumption $c \equiv (X, Y)$ and bequest b as:

$$U = \begin{cases} X^{\alpha} b^{1-\alpha} & \text{for } X \leq \bar{X} \\ (\bar{X} + Y)^{\alpha} b^{1-\alpha} & \text{otherwise} \end{cases}$$

where $0 < \alpha < 1$.

Utility is maximized subject to, $b + c \leq Z$, where Z denotes net-wealth in period 2. Since X is a basic good such as food, these preferences imply that every individual allocates income only to good X and b until the required level of good $X, \bar{X}$ has been consumed. Any residual income (after consuming $\bar{X}$ level of good X) is allocated between good Y and bequests.

From the nature of the above utility function it can be shown that an individual with net-wealth, Z, will consume $X = \alpha Z < \bar{X}$ if $Z < \frac{\bar{X}}{\alpha}$. In other words, people with net-wealth $Z > \frac{\bar{X}}{\alpha} = \tilde{Z}$ consume Y.

As the indirect utility function is increasing in net-wealth, Z, utility maximization is same as maximizing Z. Accordingly, given the inheritance level, each agent maximizes his net-wealth and make their occupational choice decisions. Now, Z equals:

$$(x + w)(1 + r) + w; \quad \text{if he decides to work as laborer} \qquad \text{(i)}$$
$$(x - g)(1 + i) + \pi; \quad \text{if he invests in set up cost and is borrower} \qquad \text{(ii)}$$
$$(x - g)(1 + r) + \pi; \quad \text{if he invests in set up cost and is lender} \qquad \text{(iii)}$$

Here x is the inheritance, w is the fixed wage of labor and π is the profit of the entrepreneurs which is endogenously determined.

Occupational choice

A person decides to invest in the set up cost if his net-wealth derived out of such investment does not fall short of that he would receive if he works as a laborer. Let e denote the threshold inheritance above which a person decides to invest in the set up cost and become an entrepreneur. By comparing (i) and (ii) we get the level of threshold inheritance for the entrepreneurial choice:

$$e = \frac{w(2 + r) + g(1 + i) - \pi}{i - r} \tag{5.1.1}$$

People with $x \geq g$ will invest as entrepreneur if their net-wealth from entrepreneurship is higher than that from working as a laborer,

$$\pi \geq g(1+r) + w(2+r) \equiv \pi_{min} \tag{5.1.2}$$

which is obtained by comparing (i) and (iii).

Let us define, people with $x < e$ (laborers) as poor; people with $e \leq x < g$ (*i.e.*, people who borrow and invest as entrepreneurs) as middle class and people with $x \geq g$ (*i.e.*, people who have enough inheritance to invest as entrepreneur) as rich.

The model endogenously eliminates the poor from consumption of Y in equilibrium by assuming a suitable value of $\bar{X}$ in $\bar{X} \geq \alpha[g(1+r) + w(2+r)]$. This is a very practicable assumption since it supports the standard empirical observations that poor people hardly consume luxury/industrial goods and are basically the consumers of basic good.[3] By this assumption we find that the net-wealth of poor (laborers) with inheritance $x(< e)$ is $[(x+w)(1+r)+w]$, which is always lower than $\tilde{Z}$, the net-wealth level above which people consume good-Y.[4]

Let us see whether middle class people consume Y in equilibrium. Suppose, net-wealth of people with inheritance 'e' is Z^e. It can be shown that $Z^e < \tilde{Z}$ so long as $e < g$ and $Z^e = \tilde{Z}$ when $e = g$.[5] Therefore, when $e < g$, all the middle class people would not consume good-Y. When $e = g$ there is no middle class, only two classes exist,

[3]Eswaran and Kotwal (1993) make a similar assumption and provide empirical support for their assumption.

[4]This is because $[(x+w)(1+r)+w] < \tilde{Z} = \frac{\bar{X}}{\alpha}$ implies, $[(x+w)(1+r)+w] < [g(1+r)+w(2+r)]$, or, $x < g$, which is true for people with $x < e$ since $e \leq$g.

[5]See Appendix 5.1.

poor ($x < e = g$) and rich ($x \geq g$) with only rich consuming good-Y.

We now consider the case $e < g$. We have seen that people belonging to middle class with wealth e do not consume Y. Now, define the threshold inheritance level of an individual belonging to the middle class and consuming Y as 's'. We can easily obtain 's' by equating a borrower's net-wealth with $\tilde{Z}$ and putting the value of $\bar{X}$ as:

$$s = \left[\frac{g(1+i) + g(1+r) + w(2+r) - \pi}{(1+i)}\right] \tag{5.1.3}$$

Therefore, people with inheritance $x > s$ have net-wealth higher than $\tilde{Z}$. Clearly, $s > e$. One may check that when $e = g$, $s = g$. Thus, $s \in [e, g]$.

Technologies

The basic good, X, is a home production type good, produced by laborers themselves under a linear technology, $X = wL$ where L denotes laborer and w is the wage.
In the other sector, an entrepreneur, j, hires laborer and faces the production function:

$$Y = AL^{\gamma}; \quad 0 < \gamma < 1$$

where A is the technology parameter.

Diminishing returns to scale in the above technology implies the presence of some fixed factor, which can be interpreted as fixed entrepreneurial effort. We assume, $A = an$ where n is the number of entrepreneurs in the economy. This is an externality in the production function which implies, the higher the number of entrepreneurs the higher is the productivity of labor. This is a 'learning by doing' type of technology as in Matsuyama (2002) where the productivity improves with the output produced. Paternostro (1997) also introduces similar externality in production, where the fixed cost faced by

each monopolist is a decreasing function of the number of firms that industrialize.

Let p denote the price of good-Y. The profit of each entrepreneur-j is equal to $\pi_j = pAL_j^{\gamma} - wL_j$. The profit-maximizing level of the skilled labor employment is determined by

$$w = p\gamma AL_j^{\gamma-1}$$

From this we get,

$$L_j = \left(\frac{pA\gamma}{w}\right)^{\frac{1}{1-\gamma}} = \bar{L}(say) \tag{5.1.4}$$

Assuming all entrepreneurs are identical in their profit maximizing behavior,

$$\pi_j = p(1-\gamma)AL_j^{\gamma} = p(1-\gamma)Y_j = \pi \tag{5.1.5}$$

For further characterization, we assume a Pareto distribution of wealth, a very standard form of distribution used in the literature, whose density function is given by

$$f(x) = \frac{\lambda m^{\lambda}}{x^{\lambda+1}}; \quad x \geq m > 0, \lambda > 0$$

where λ is the Pareto inequality parameter. The higher the value of λ, the greater is the number of people concentrated at the lower wealth levels, hence the higher is the degree of inequality. The cumulative density function has the expression:

$$F(x) = \int_m^x \frac{\lambda m^{\lambda}}{X^{\lambda+1}} dX = 1 - \left(\frac{m}{x}\right)^{\lambda} \tag{5.1.6}$$

From this we get the number of entrepreneurs, n, of an economy with inequality λ as $[1 - F(e)] = \left(\frac{m}{e}\right)^{\lambda}$.

Once we know that people with inheritance above 's' consume good-Y and the demand of good-Y for every individual, we can find aggregate market demand for Y using Pareto distribution. Again, we know people with inheritance above 'e' become entrepreneurs and the supply of each entrepreneur is also known, hence we get aggregate supply of good-Y. Equating aggregate demand and aggregate supply we obtain equilibrium price of good-Y, hence the profit of entrepreneurs from (5.1.5) using (5.1.4).

5.1.1 Determination of equilibrium profit

We denote the demand for good-Y as Y^d. From utility maximizing behavior of individuals with net-wealth $Z(\geq \tilde{Z})$ and budget constraint $\bar{X} + pY^d + b = Z$ we get $Y^d = \left[\frac{\alpha Z - \bar{X}\{\alpha+(1-\alpha)p\}}{p}\right]$. From this the aggregate market demand for Y, AD^Y, is derived as:

$$\begin{aligned} AD^Y &= \frac{\alpha}{p}\left\{\int_s^g [(x-g)(1+i)+\pi]f(x)dx + \int_g^\infty [(x-g)(1+r)+\pi]f(x)dx \right. \\ &\quad \left. -[1-F(s)]\left[1+\left(\frac{1-\alpha}{\alpha}\right)p\right]\bar{X}\right\} \\ AS^Y &= [1-F(e)]Y_j^s = [1-F(e)]\frac{\pi}{(1-\gamma)p} = \left(\frac{m}{e}\right)^\lambda \frac{\pi}{(1-\gamma)p} \end{aligned}$$

where AS^Y is the aggregate supply of the industrial good. By $AD^Y = AS^Y$ we obtain equilibrium profit for an economy.

5.1.2 Entrepreneurial subsidy and welfare

Depending upon the inequality level the equilibrium profit might be low enough such that only rich people get incentive to invest as entrepreneurs, *i.e.*, $\pi^* = \pi_{min}$. The central planner of such an economy, where entrepreneurship is confined to the rich class might desire to encourage entrepreneurship among the low-wealth group by an entrepreneurial

subsidy policy. Let us see how effective is such a policy with respect to welfare.

Suppose the central planner provides a subsidy to the entrepreneurs by reducing the set up cost from g to g' and finances it by imposing tax T on rich (with wealth $x \geq g$). Since the set up cost is reduced, the number of entrepreneurs increases and in equilibrium the profit again reaches its minimum. In the post-subsidy situation individuals with wealth $g' \leq x < g$ who have sufficient inheritance to incur the reduced set up cost, g', are the new group of entrepreneurs. The net-wealth of individuals who are now encouraged to invest as entrepreneurs for inheritance x is $[(x - g')(1 + r) + \pi']$. Since the new profit π' is $[g'(1 + r) + w(2 + r)]$ the net-wealth is $[(x + w)(1 + r) + w]$. This is same as the net-wealth without subsidy. Clearly, such a subsidy scheme does not help the new class of entrepreneurs in utility terms.

Again, the poor will not gain from this scheme as their net-wealth both before and after the subsidy scheme is $[(x + w)(1 + r) + w]$ for any inheritance x. Now, let us see what happens to the utility of the rich individuals. From the planner's balanced budget we get,

$$(g - g')[1 - F(g')] = T[1 - F(g)] \tag{5.1.7}$$

where $F(\cdot)$ denotes the cumulative distribution of wealth, which is Pareto and T is one of the following:

$$T = \begin{cases} t & \text{(lumpsum)} \\ tx & \text{(proportional)} \\ tx^2 & \text{(progressive)} \end{cases}$$

Now, the net-wealth of rich for inheritance x is $[(x - g')(1 + r) + \pi' - T]$ which is same as $[(x + w)(1 + r) + w - T]$ since $\pi' = \pi_{min}(g')$. This is obviously lower than the net-wealth without tax. Since the supply increases, price of good-Y decreases which

raises the utility of its consumers. Thus, rich people gain via a fall in its price but loses via a loss in net-wealth. It depends on the relative fall in the price and the relative fall in net-wealth. It can be shown that in both the lump sum tax and proportional tax case highly rich individuals gain but in case of progressive tax, the fall in price can not compensate for the tax burden for the highly rich people. The rich people at the lower margin of wealth (below $\hat{x}$),[6] lose in all the cases since their net-wealth reduces by the tax and they are no more the consumers of the good. Thus,

Proposition 5.1.1. *An entrepreneurial subsidy policy financed by a tax on the rich does not raise utility of the new group of entrepreneurs and that of the poor. Such a policy only changes the net-wealth distribution of the rich. The rich people at the low-wealth margin (below $\hat{x}$) lose in all the three types of taxation whereas in both lump sum and proportional taxation rich individuals with high wealth gain while under progressive tax highly rich individuals are worse-off.*

5.2 International trade

So far we have assumed no trade in the luxury good sector. We now relax this assumption. Suppose our economy is a small open economy that allows international trade in sector-Y and faces an internationally given price of good-Y, $\bar{p}$.

From (5.1.5) we know the profit of each of the domestic entrepreneurs and hence we get equilibrium π^T, π^{T*}, given λ by (5.2.1).

$$\begin{aligned} \pi^T &= (1-\gamma)(an^T\bar{p})^{\frac{1}{1-\gamma}}\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} \\ &\equiv \Gamma_1(\pi^T;\lambda) \end{aligned} \tag{5.2.1}$$

where $n^T = (\frac{m}{e^T(\pi^T)})^{\lambda}$.

[6] See Appendix 5.2.

Given the external price, we assume that g is not too low otherwise, too many people would invest as entrepreneurs and with immobility of labor across economies, production would not be feasible.[7]

It is obvious that π^{T*} depends on $\bar{p}$ and clearly π^{T*} decreases as $\bar{p}$ falls. We know from the incentive compatibility constraint of entrepreneurs, (5.1.2), that if $\pi^{T*} < \pi_{min}$ there will be no entrepreneur. Suppose, when trade is opened up in an economy with inequality λ, the externally given price of good-Y is such that the profit just satisfies (5.1.2). Then from (5.2.1) we obtain the value of $\bar{p}$ for which $\pi^{T*} = \pi_{min}$, $\bar{p}^*$, as follows.

$$\bar{p}^* = \frac{[w(2+r)+g(1+r)]^{1-\gamma}}{a(1-\gamma)^{1-\gamma}\left(\frac{\gamma}{w}\right)^{\gamma}}.\left(\frac{g}{m}\right)^{\lambda} \tag{5.2.2}$$

Clearly, if $\bar{p} < \bar{p}^*$ the profit will be too low to provide any incentive to the entrepreneurs and sector-Y will not exist. The luxury good will be imported in that case for the rich individuals who are the sole consumers of the good.

Notice that the higher the inequality the higher is the critical price level below which the luxury good sector will not exist once trade is opened up. This has an interesting implication. Suppose the externally given price is $\bar{p}$ and $\bar{\lambda}$ is the inequality level for which the sector just exists or $\pi^{T*}(\bar{\lambda}) = \pi_{min}$. Then all economies with higher inequality level $\lambda > \bar{\lambda}$ will have $\bar{p}^*(\lambda) > \bar{p}^*(\bar{\lambda}) = \bar{p}$ which implies $\pi^{T*}(\lambda) < \pi^{T*}(\bar{\lambda}) = \pi_{min}$ or the luxury good sector will not exist for those economies. Since $\bar{p} = \bar{p}^*(\bar{\lambda})$, we can solve for $\bar{\lambda}$ from $\pi^T(\bar{\lambda}|\bar{p}) = \pi_{min}$ as

$$\bar{\lambda} = \frac{ln\left(\frac{\bar{p}a(1-\gamma)^{1-\gamma}\left(\frac{\gamma}{w}\right)^{\gamma}}{[w(2+r)+g(1+r)]^{1-\gamma}}\right)}{ln\left(\frac{g}{m}\right)} \tag{5.2.3}$$

From this the next proposition follows.

[7] We assume $g > g_{min}$. See Appendix 5.4 for g_{min}.

Proposition 5.2.1. *(i) When a small open economy with inequality λ opens up trade in the luxury good sector, it will cease to exist if $\bar{p} < \bar{p}^*(\lambda)$ where $\bar{p}^*(\lambda)$ is defined in (5.2.2). The luxury good will be imported in that case and the rich people being the sole consumers of the good will enjoy the entire benefit of globalization via a low price of the good. (ii) If the externally given price of the luxury good is such that the sector just exists for an economy then it will never exist for all economies with the inequality level higher than that economy.*

Suppose, when trade is opened up, $\bar{p}$ is such that sector-Y ceases to exist for an economy with inequality λ. Let us see whether the sector exists in the next period. Let us suppose the sector just exists. Then, $\pi^T_{t+1} = \pi_{min}$ and $n_{t+1} = [1 - F_{t+1}(g)]$ where $F_{t+1}(\cdot)$ is the wealth distribution in period $(t+1)$. Then

$$(1-\gamma)(an_{t+1}\bar{p})^{\frac{1}{1-\gamma}}\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} \quad = \quad \pi_{min}$$

This gives us,

$$n_{t+1} \quad = \quad \frac{\pi_{min}}{(1-\gamma)(a\bar{p})^{\frac{1}{1-\gamma}}\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}} \tag{5.2.4}$$

We know that for this economy

$$\bar{p} < \bar{p}^* = \frac{[w(2+r)+g(1+r)]^{1-\gamma}}{a(1-\gamma)^{1-\gamma}\left(\frac{\gamma}{w}\right)^{\gamma}} \cdot \left(\frac{g}{m}\right)^{\lambda}$$

Using this it follows from (5.2.4) that

$$n_{t+1} \quad > \quad \left(\frac{m}{g}\right)^{\lambda} \tag{5.2.5}$$

We have $[1-F_t(g)] = \left(\frac{m}{g}\right)^{\lambda}$. When $\pi^T_{t+1} = \pi_{min}$, $e_{t+1} = g$. This gives $n_{t+1} = [1-F_{t+1}(g)]$.

We have seen that when the sector does not exist people work as laborer and earn net-wealth $[(x+w)(1+r)+w]$ given the inheritance x. The bequest function is generated

by utility maximization, which gives the dynamics of wealth as:

$$x_{t+1} = (1-\delta)[(x_t + w)(1+r) + w]$$

Since people keep a fraction $(1-\delta)(1+r)$ of their inheritance x as bequest, It is obvious that some individuals with inheritance $x \geq g$ keep bequest $x_{t+1} < g$ which implies, $[1 - F_{t+1}(g)] < [1 - F_t(g)]$ hence, $n_{t+1} < \left(\frac{m}{g}\right)^{\lambda}$. This violates (5.2.5) and we find $\pi^T_{t+1} < \pi_{min}$ which implies that the sector will not exist in period $(t+1)$ too. In fact, one can show that the sector does not exist in subsequent periods and the economy converges to the low-level wealth

$$x^* = \frac{(1-\delta)w(2+r)}{1-(1-\delta)(1+r)}$$

Proposition 5.2.2. *Economies with high inequality $\lambda > \bar{\lambda}$ converge to a low-level wealth in the long run when trade is opened up in the industrial sector.*

5.3 Policy implications with international trade

5.3.1 Entrepreneurial subsidy

We have seen that opening up of trade in highly unequal economies leads to non-existence of the industrial sector and the economy eventually converges to a low-wealth equilibrium in the long run. Suppose the industrial sector does not exist. Let us now see whether the sector exists if the central planner reduces the cost of investment by an entrepreneurial subsidy while it opens the sector to trade. Let $\bar{g}$ denote the new set up cost. Suppose it is financed by an equal amount of lump sum tax T on the rich. The net-wealth Z of different group are:

$$Z = \begin{cases} (x+w)(1+r)+w & \text{for } x < e \quad \text{(i)} \\ (x-\bar{g})(1+i)+\pi(\bar{g}) & \text{for } e \leq x < \bar{g} \quad \text{(ii)} \\ (x-\bar{g})(1+r)+\pi(\bar{g}) & \text{for } \bar{g} \leq x < g \quad \text{(iii)} \\ (x-\bar{g})(1+r)+\pi(\bar{g})-T & \text{for } x \geq g \quad \text{(iv)} \end{cases}$$

where $\pi(\bar{g})$ is profit under the tax-subsidy scheme.

Since the indirect utility function is increasing in net-wealth we plot the net-wealth Z in Figure 5.1 to compare the utility levels. The dark lines show the net-wealth for different class of people after the subsidy scheme and the dotted dark line segments show the same without subsidy. For poor ($x < e$) the two lines coincide since subsidy does not make any change to their utility. For people with $e \leq x < g$ we find that the post-subsidy net-wealth is higher compared to the case of no subsidy while that of the rich with $x \geq g$ and those who are taxed may be higher depending upon the tax rate and obviously on the amount of subsidy. We know that the total tax finances the subsidy. Hence,

$$(g-\bar{g})[1-F(\bar{g})] \;=\; T[1-F(g)]$$

where $F(\cdot)$ denotes the cumulative wealth distribution which is assumed to be Pareto. Thus we get T as

$$T \;=\; (g-\bar{g})\left(\frac{g}{\bar{g}}\right)^{\lambda}$$

Clearly, from Figure 5.1, the subsidy scheme benefits all people who borrow to invest and people with $\bar{g} \leq x < g$. If one can show that people with $x \geq g$ also gain, one can conclude that such a subsidy scheme is beneficial to all the entrepreneurs.

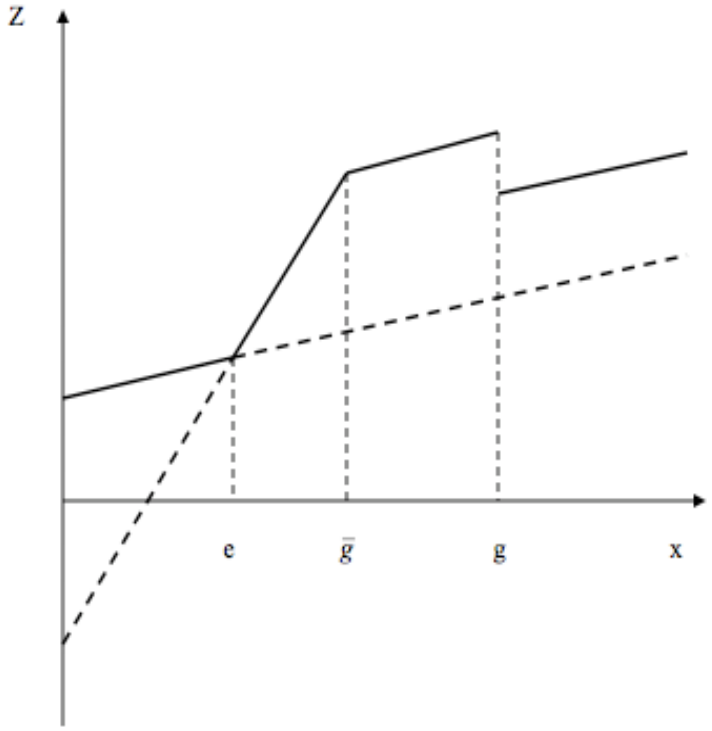

Figure 5.1: Net-wealth with and without subsidy

The rich would gain if their net-wealth with subsidy $[(x-\bar{g})(1+r)+\pi(\bar{g})-T]$ is higher than that without subsidy, $[(x+w)(1+r)+w]$. Therefore, the condition that the rich would benefit from such a subsidy scheme is

$$\pi(\bar{g}) > w(2+r)+\bar{g}(1+r)+(g-\bar{g})\left(\frac{g}{\bar{g}}\right)^{\lambda} \tag{5.3.1}$$

In Figure 5.1, the dark line for rich ($x \geq g$) is above the dotted one when (5.3.1) is satisfied depicting higher utility for the rich under subsidy.

Now, let $\phi = w(2+r)+\bar{g}(1+r)+(g-\bar{g})\left(\frac{g}{\bar{g}}\right)^{\lambda}$ and define π^{**} as $\Gamma_1(\pi^{**};\lambda)=\phi$ where $\Gamma_1(\pi^{**};\lambda)$ is defined in (5.2.1). This leads to the following lemma.

Lemma 5.3.1. *If* $\frac{\phi(\bar{g})}{\pi^{**}(\bar{g})} > 1$ *then* $\pi(\bar{g}) > \phi(\bar{g})$ *or the inequality in (5.3.1) gets satisfied.*[8]

[8]For proof see Appendix 5.3.

We can easily obtain π^{**} as

$$\pi^{**} = w(2+r) + (1+i)\bar{g} - K^{1/\delta}(i-r)\phi^{-1/\delta}$$

where $K = (1-\gamma)(ap)^{\frac{1}{1-\gamma}} m^{\frac{\lambda}{1-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}$ and $\delta = \frac{\lambda}{1-\gamma}$.

Then applying Lemma 5.3.1 and rearranging terms we get the condition for which the inequality in (5.3.1) is satisfied as

$$\phi^{1+\frac{1}{\delta}} - [w(2+r) + (1+i)\bar{g}]\phi^{\frac{1}{\delta}} + K^{\frac{1}{\delta}}(i-r) > 0 \tag{5.3.2}$$

From this the next proposition follows.

Proposition 5.3.1. *The policy of an entrepreneurial subsidy financed by an equal amount of tax on the rich along with opening up of trade is Pareto-improving if the condition in (5.3.2) holds.*

We now calibrate the model to find a range of $\bar{g}$ that satisfies the inequality in (5.3.2). The values of the parameters for this calibration exercise are shown in Table 5.1.

Table 5.1: Values of parameters for calibration

$\bar{p}$	w	g	a	γ	i	r	m	λ
.23	.75	2	110	.5	.16	.08	.2	1.0006

We have calculated the critical price level for existence of the industrial sector in this economy as $\bar{p}^* = .3041$. Clearly, this is higher than the externally given price $\bar{p} = .23$ which implies, the industrial sector does not exist when only trade is opened up in the sector. Now, let us see whether there exists any suitable range of $\bar{g}$ that helps the sector to exist and the subsidy policy is Pareto-improving as well.

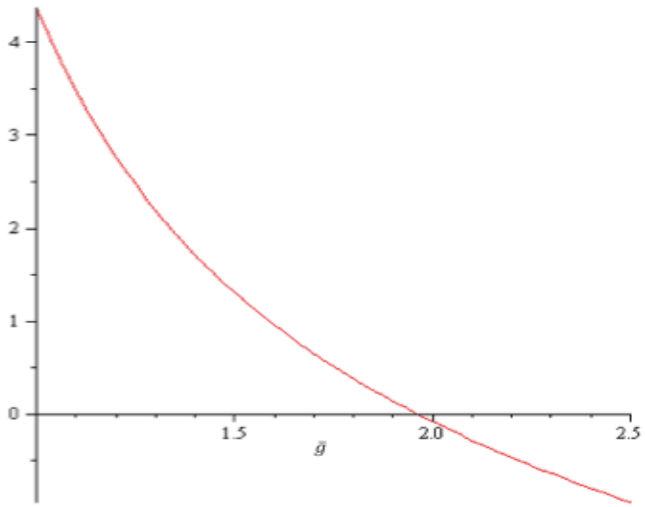

Figure 5.2: Suitable range of $\bar{g}$ satisfying the inequality in (5.3.2)

To show that the subsidy policy is Pareto-improving we need to show that there exists a suitable range of values for $\bar{g}$ that satisfy the inequality in (5.3.2). From Figure 5.2 that plots the left-hand-side of (5.3.2) for different values of $\bar{g}$, we get the range of $\bar{g}$ satisfying (5.3.2). We know that for the existence and uniqueness of equilibrium profit, $\bar{g}$ should neither be too low nor too high; in fact, it has to lie between $\bar{g}_{min}$ and $\bar{g}_{max}$. We calculate that $\bar{g}_{min} = 1.23$ and $\bar{g}_{max} = 1.6$.[9] From Figure 5.2 we find, any $\bar{g}$ in the range $0 \leq \bar{g} \leq 1.95$ satisfies (5.3.2). Therefore, the suitable range of values for $\bar{g}$ under the subsidy policy may be $(1.23, 1.6)$.

5.3.2 Entry of foreign firms

We have seen that mere opening up of trade in the luxury good sector may lead to non-existence of the sector depending upon the inequality level of the economy; however, it helps the consumers of the imported industrial good or the rich to gain via its cheaper price. Therefore, the crucial question is not 'whether to globalize' but 'how to

[9]See Appendix 5.4 for $\bar{g}_{min}$ and $\bar{g}_{max}$.

globalize' to spread the benefits more evenly. In this model the assumption of externality in production of good-Y plays an important role in choosing a suitable policy and make globalization more inclusive. The number of operating firms in the domestic economy has a positive externality on the labor productivity. In other words, the higher the number of entrepreneurs working in the economy the higher is the productivity of labor. Suppose, trade is opened up in sector-Y and the planner allows some foreign firms to enter the economy and produce good-Y along with the domestic firms. Such an increase in the number of operating firms in the domestic economy raises the labor productivity hence the profit of entrepreneurs, which in turn induces some of the low-wealth individuals to work as entrepreneurs and enjoy higher utility via a higher income.

Let us denote the number of foreign firms as n_f. Suppose, the number of domestic firms is n when trade is opened up in sector-Y and n_f foreign firms are allowed to start production in the domestic economy. The profit eqn. (5.2.1) now gets modified to

$$\pi^T = (1-\gamma)[a(n+n_f)\bar{p}]^{\frac{1}{1-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} \tag{5.3.3}$$

Clearly, this gives higher equilibrium profit since $n_f > 0$. Thus,

Proposition 5.3.2. *The policy of opening up of trade in the luxury good sector and allowing some foreign firms to operate in the domestic economy might help the industrial sector to exist and make globalization more inclusive by raising the profit that induces low-wealth individuals to invest as entrepreneurs.*

5.4 Conclusion

The chapter relates wealth inequality and entrepreneurship in a model of occupational choice. It presents a model of a two good economy where everyone consumes the basic good and people consume the luxury good only after consuming a certain minimum of the basic good. Thus, it is the high-wealth individuals who can meet this minimum

consumption need of the basic good and incline to consume the luxury good. On the supply side, people choose between the occupations entrepreneurship and laborer. They have to incur an indivisible set up cost to become entrepreneur. The chapter emphasizes that under a restricted trade regime, given the wealth distribution of an economy, if the equilibrium profit is at the minimum satisfying the incentive compatibility constraint of entrepreneurship then only rich people will invest as entrepreneurs. Then an entrepreneurial subsidy policy financed by an equal amount of lump sum tax on the rich is not a very effective policy to encourage entrepreneurship among low-wealth individuals since it does not raise the utility of the new group of entrepreneurs.

The chapter also analyzes the trade equilibrium in a small open economy and explains that when trade is opened up in the luxury good sector the sector may not exist if the externally given price of the good is too low, depending upon the inequality level of the economy. When the sector does not exist, the rich people being the sole consumers of the industrial good, the benefits of globalization would go entirely to them via a lower price of the imported good. In unequal economies where the industrial sector ceases to exist when trade is opened up, an entrepreneurial subsidy policy financed by a lump sum tax on the rich might help the sector to exist and the policy might be Pareto-improving too. The chapter suggests another policy to make globalization more inclusive. Assuming an externality in the production of the industrial good, which raises the productivity of labor with an increase in the number of entrepreneurs, the chapter shows that the policy of allowing some foreign firms in the economy might help the sector to exist creating sufficient incentive to entrepreneurship. Thus, suitable complementary policy measures rather than merely opening up of trade helps to spread the benefits of globalization more evenly and makes it more inclusive.

5.5 Appendix

Appendix 5.1

We will prove $Z^e \leq \tilde{Z}$ where $Z^e = [(e-g)(1+i)+\pi]$ is the net-wealth of an individual with inheritance 'e'. $Z^e > (\leq)\tilde{Z}$ holds according as

$$[(e-g)(1+i)+\pi] \quad > (\leq) \quad [g(1+r)+w(2+r)]$$

Putting the value of 'e' from (5.1.1) and re-arranging terms we find the condition for $Z^e > (\leq)\tilde{Z}$ to hold as:

$$[g(1+r)+w(2+r)-\pi](1+i)+(i-r)\pi \quad > (\leq) \quad [g(1+r)+w(2+r)](i-r)$$

$$or, \quad \pi \quad < (\geq) \quad [g(1+r)+w(2+r)]$$

From (5.1.2), we know that the incentive compatibility constraint for entrepreneurs $\pi \geq [g(1+r)+w(2+r)]$ must hold. This proves, $Z^e \leq \tilde{Z}$.

Now, when $\pi = [g(1+r)+w(2+r)]$, we find from (5.1.1) that $e = g$ holds and when $\pi > [g(1+r)+w(2+r)]$, $e < g$. These together imply, when $e = g$, $Z^e = \tilde{Z}$ and when $e < g$, $Z^e < \tilde{Z}$.

Appendix 5.2

We will consider the following cases:

$$T = \begin{cases} t & \text{(lumpsum)} \\ tx & \text{(proportional)} \\ tx^2 & \text{(progressive)} \end{cases}$$

We know that imposition of tax on rich reduces the net-wealth and clearly those who are at the margin *i.e.*, with inheritance x around g, do not consume the industrial good.

Obviously, their utility falls after the tax-subsidy scheme. Now, let us see what happens to the utility of the consumers of good-Y since its price falls but their net-wealth falls too.

Given that the demand for Y is $\left[\frac{\alpha Z-\bar{X}\{\alpha+(1-\alpha)p\}}{p}\right]$. Putting this in the utility function one can obtain:

$$U = \left(\frac{1-\alpha}{\alpha}\right)^{1-\alpha}\left[\frac{Z-\bar{X}(1-p)}{p^{\alpha}}\right]$$

where $Z=[(x+w)(1+r)+w]$. We will check whether U falls (or rises) by an imposition of tax T.

$$\Delta U = \left(\frac{1-\alpha}{\alpha}\right)^{1-\alpha}\left[\frac{p^{\alpha}(\Delta Z+\Delta p\bar{X})-\alpha p^{\alpha-1}\Delta p(Z-\bar{X}(1-p))}{p^{2\alpha}}\right]$$

where $\Delta Z=-T$. Since $\Delta p<0$, $\Delta U>0$ if

$$\left|\frac{\Delta p}{p}\right| > \frac{T}{(Z-\bar{X})} = R \quad (say) \tag{$A5.1$}$$

We can solve for the critical level of inheritance $\hat{x}$ (say) at which $(A5.1)$ is just satisfied or the inheritance level above which $\Delta U>0$ as:

$$\hat{x} = \left[\frac{T}{\left|\frac{\Delta p}{p}\right|(1+r)}+\alpha\left\{g-\left(\frac{1-\alpha}{\alpha}\right)\frac{w(2+r)}{(1+r)}\right\}\right]$$

Clearly, if T is a lump sum tax then the right-hand-side of $(A5.1)$ falls as x rises hence for the highly rich individuals $\Delta U>0$ holds *i.e.*, utility rises under the scheme.

Now suppose the value of tax on each individual T is 'tx'. Then right-hand-side of $(A5.1)$ becomes $\frac{tx}{(Z-\bar{X})}$.

$$\frac{dR}{dx}=\frac{t(Z-\bar{X})-tx(1+r)}{(Z-\bar{X})^2}<0$$

since $w(2+r) < \bar{X}$ if g is sufficiently large. Therefore, R decreases for higher x and $(A5.1)$ is satisfied. Thus, the utility of highly rich individuals increases by this scheme.

In case of progressive taxation the tax on each individual is $T = tx^2$. Then

$$\frac{dR}{dx} = \frac{2tx(Z - \bar{X}) - tx^2(1+r)}{(Z - \bar{X})^2}$$

Clearly, $\frac{dR}{dx} < 0$ if $x < 2\alpha \left[g - \left(\frac{1-\alpha}{\alpha}\right) \frac{w(2+r)}{(1+r)} \right]$. which implies, the richer a person is with $x > 2\alpha \left[g - \left(\frac{1-\alpha}{\alpha}\right) \frac{w(2+r)}{(1+r)} \right]$, the higher is the possibility that he loses by the tax-subsidy scheme such that $(A5.1)$ no longer satisfies for him.

Appendix 5.3: Proof of Lemma 5.3.1

We know that

$$\phi(\bar{g}) = w(2+r) + \bar{g}(1+r) + (g - \bar{g}) \left(\frac{g}{\bar{g}}\right)^{\lambda}$$

and π^{**} solves $\Gamma_1(\pi, \bar{g}) = \phi(\bar{g})$.

Let us define equilibrium profit for the set up cost $\bar{g}$ as π_{eq}. Now, we will prove Lemma 5.3.1 diagrammatically. In Figure 5.3 we plot $\phi(\bar{g})$ and $\Gamma_1(\pi)$ against π. Equilibrium profit or π_{eq} is that value of π where the function plotting $\Gamma_1(\pi)$ intersects the 45° line. We obtain π^{**} as the point of intersection of $\phi(\bar{g})$ and $\Gamma_1(\pi)$. For the value of π^{**} where ϕ and the 45° line intersects it is clear that $\frac{\phi(\bar{g})}{\pi_1^{**}} = 1$ and obviously for any π^{**} higher than that we will have $\frac{\phi(\bar{g})}{\pi_1^{**}} < 1$. Thus, if the function $\Gamma_1(\pi)$ is such that it is plotted as the curve A_1B_1 then $\frac{\phi(\bar{g})}{\pi_1^{**}} < 1$ and in this case we find from Figure 5.3 that $\pi_{eq1} < \phi(\bar{g})$, which implies the condition (5.3.2) is violated. If, on the other and, the function $\Gamma_1(\pi)$ plots like A_2B_2 then $\frac{\phi(\bar{g})}{\pi_2^{**}} > 1$ and (5.3.2) is satisfied since Figure 5.3 shows that $\pi_{eq2} > \phi(\bar{g})$.

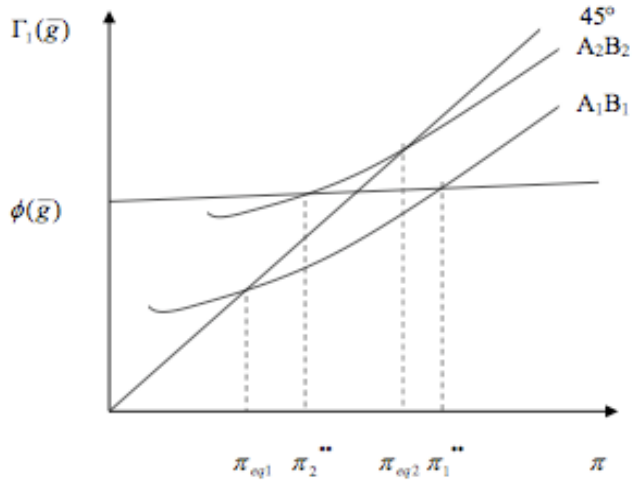

Figure 5.3: Proof of Lemma 5.3.1

Appendix 5.4

Suppose the sector exists and let π_{eq} be the solution of $\Gamma_1(\pi) = \pi$ where

$$\Gamma_1(\pi) = (1-\gamma)\{a\bar{p}n(\pi)\}^{\frac{1}{1-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} \qquad (A5.2)$$

$$n(\pi) \;=\; \left(\frac{m}{e}\right)^{\lambda} = \left(\frac{m(i-r)}{w(2+r)+\bar{g}(1+i)-\pi}\right)^{\lambda}$$

We know that for $\pi < \pi_{min}$, no one will be entrepreneur *i.e.*, $n = 0$ which implies $\Gamma_1(\pi) = 0$ where $\pi_{min} = w(2+r)+\bar{g}(1+r)$. Therefore, $\pi_{eq} = 0$ is the solution of (A5.2) when the sector does not exist.

For the ease of notation, we define the following:

$$K \;=\; (1-\gamma)(a\bar{p})^{\frac{1}{1-\gamma}} m^{\frac{\lambda}{1-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}$$
$$\delta \;=\; \frac{\lambda}{1-\gamma}$$

Define π_{max} such that the number of entrepreneurs is the highest feasible value for an economy, in other words, the number of laborers required for production by them just

equals the labor stock of the economy. We know from (5.1.4) that the number of laborers required by each entrepreneurs, given the price $\bar{p}$ is $L = \left(\frac{\bar{p}A\gamma}{w}\right)^{\frac{1}{1-\gamma}} = \hat{L}\left(\frac{m}{e}\right)^{\frac{\lambda}{1-\gamma}}$ where $\hat{L} = \left(\frac{\bar{p}a\gamma}{w}\right)^{\frac{1}{1-\gamma}}$. Therefore, we solve for π_{max} using Pareto density function as

$$\begin{aligned}[1-F(e)]L &= F(e) \\ or, \quad \hat{L} &= \left(\frac{e}{m}\right)^{\frac{\lambda}{1-\gamma}}\left[\left(\frac{e}{m}\right)^{\lambda}-1\right]\end{aligned}$$

Since the right-hand-side is increasing in 'e' we can solve for e that satisfies above equation, e^*, and from that get π_{max}. Note that e^* falls as $\bar{g}$ increases since e is an increasing function of $\bar{g}$. Putting the value of e from (5.1.1) we get

$$\pi_{max} = w(2+r) + \bar{g}(1+i) - e^*(i-r)$$

For uniqueness of the solution of π we must have $\pi_{max}(\lambda) > \Gamma_1(\pi_{max}, \lambda)$. Therefore, the sufficient condition for uniqueness is

$$(1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}\{a\bar{p}\}^{\frac{1}{1-\gamma}}\left(\frac{1}{\hat{L}\left(\frac{m}{e^*}\right)^{\frac{\lambda}{1-\gamma}}+1}\right)^{\frac{1}{1-\gamma}} < w(2+r) + \bar{g}(1+i) - e^*(i-r)$$

which implies

$$w(2+r) > (1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}\{a\bar{p}\}^{\frac{1}{1-\gamma}}\left(\frac{1}{\hat{L}\left(\frac{m}{e^*}\right)^{\frac{\lambda}{1-\gamma}}+1}\right)^{\frac{1}{1-\gamma}} - \bar{g}(1+i) + e^*(i-r) \quad (A5.3)$$

The righ-hand-side of the above inequality is decreasing in $\bar{g}$. Thus we get a unique $\bar{g}$ above which the inequality in (A5.3) is satisfied. This gives us g_{min} above which $\bar{g}$ must lie to satisfy the above inequality and hence the sufficient condition for uniqueness of π_{eq}.

Again, for the industrial sector to exist we must have $\pi_{eq} > 0$ for which we need to satisfy $\Gamma_1(\pi_{min}, \lambda) > \pi_{min}$ which implies

$$(1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}(a\bar{p})^{\frac{1}{1-\gamma}}\left(\frac{m}{\bar{g}}\right)^{\frac{\lambda}{1-\gamma}} - w(2+r) - \bar{g}(1+r) > 0 \qquad (A5.4)$$

Since the left-hand-side of the above inequality diminishes as $\bar{g}$ increase, the above inequality will be satisfied if $\bar{g}$ is less than a maximum value, g_{max}, obtained by solving (A5.4) with equality. This basically implies that if $\bar{g}$ is too high nobody would be interested to become entrepreneur and we would not get any equilibrium with $\pi > 0$. Therefore, we must have $g_{min} < \bar{g} < g_{max}$ under the subsidy policy for existence and uniqueness of π_{eq}.

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