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Working Paper

Invest, expropriate, or wait? Expected income and the demand for redistribution

Diskussionsbeiträge - Serie I, No. 305

Provided in Cooperation with:

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Suggested Citation: Harms, Philipp; Zink, Stefan (2000) : Invest, expropriate, or wait? Expected income and the demand for redistribution, Diskussionsbeiträge - Serie I, No. 305, Universität Konstanz, Fachbereich Wirtschaftswissenschaften, Konstanz

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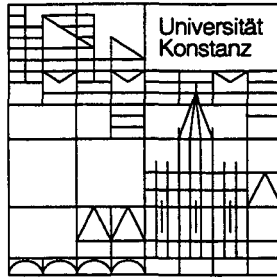
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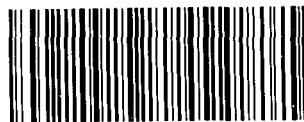
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**Invest, Expropriate, or Wait?
Expected Income and the
Demand for Redistribution**

W 284 (305)



Diskussionsbeiträge

78457 Konstanz

11. AUG. 2000 Weltwirtschaft
Riel

W 284 (305) Bei Es sig 71.

Serie I — Nr. 305

August 2000

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Invest, Expropriate, or Wait? Expected Income and the Demand for Redistribution

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University of Konstanz, June 2000

Abstract

In this paper we offer an explanation why a poor majority does not necessarily expropriate a rich minority. We present a dynamic model in which individuals are willing to accept an unequal distribution of income in the current period if they are sufficiently optimistic about their future economic prospects. In this case, the fact that a policy of radical redistribution inflicts a persistent damage on the economy and thus reduces agents' future earning possibilities prevents the poor from expropriating the rich. Unlike previous contributions, we do not assume exogenous changes of the income distribution, but relate such changes to agents' rational investment decisions.

JEL Classification: D31, D72, P16

Keywords: Political economy, Inequality, Redistribution of income.

*We are indebted to Jürgen Meckl, Anke Kessler, and seminar participants at the University of Konstanz for helpful comments. Of course, all remaining errors are ours. Correspondence address: University of Konstanz, Department of Economics, Fach D 138, D-78457 Konstanz, Germany. Phone: +49-(0)7531-88-3711, email: philipp.harms@uni-konstanz.de, stefan.zink@uni-konstanz.de.

1 Introduction

Why don't the poor expropriate the rich? Given the skewness of most countries' distributions of income and wealth, it is a puzzling observation that usually the majority of agents with incomes below the mean does not use its political power in order to implement a redistributive policy at the expense of the rich minority, and that episodes of radical redistribution are rather an exception than the norm.

The explanation we offer in this paper emphasizes the notion that agents are willing to live with a considerable degree of inequality as long as they have a realistic perspective of being better off in the future. The crucial assumptions on which this argument is based are that redistributive policies inflict a persistent damage on the economy, and that agents have indeed a "prospect of upward mobility" which would be sacrificed in case of a radical redistribution. If these conditions are satisfied, it is possible that a poor majority trades off current transfers resulting from redistributive policies against future earning possibilities and that agents therefore oppose a policy which would maximize their current income.

Our paper is complementary to a number of earlier contributions that explain why an uneven distribution of income need not result in large-scale redistribution by either stressing the incentive effects of redistributive policies, the characteristics of the political process, agents' expectations about their future incomes, their experience of social mobility, or concerns about social status¹: the seminal paper by Meltzer and Richard (1981) belongs into the first category by emphasizing the fact that a higher tax on labor incomes reduces the labor supply of those individuals who are more productive and thus lowers the tax base. Perotti (1993) derives a politico-economic equilibrium in which the poor refrain from excessively taxing those agents who have a higher earning ability in order to provide them with an incentive to acquire education and in order to benefit from an external effect through which the number of educated workers raises their own wage in the future. Roemer (1998) concentrates on the political process and shows that an uneven distribution of incomes need not automatically result in a policy of excessive redistribution if parties compete on multiple issues. In Breyer and Ursprung (1998), the rich class prevents expropriation by agreeing on a mildly redistributive policy at the constitutional stage of the political process, thus bribing the politically pivotal middle class. Finally, Falkinger (1999) presents a

¹Putterman (1997) offers a survey of competing theories.

model in which moderate redistribution is used in order to prevent the poor from destabilizing the economic order. The classical paper that emphasizes intertemporal considerations as a determinant of agents' attitude towards redistribution is Hirschman (1973): according to his view, agents are willing to tolerate a high degree of inequality during periods of rapid economic growth as long as they consider the income of those agents who advance faster as a predictor for their own future prosperity. In Piketty (1995), agents' past experience of social mobility determines their attitude towards redistribution and thus the outcome of the political process. In Corneo and Grüner (2000), concerns about their social status limit agents' desire to redistribute.

The paper closest to our analysis is Benabou and Ok (1998) who also stress the "prospect of upward mobility" as the crucial impediment to an extremely redistributive policy: if the distribution of income is expected to narrow in the future and if redistributive policies are persistent, the median voter may oppose taxation even if his current income is below the economy-wide average. While the paper by Benabou and Ok (1998) offers important insights on the effect of the *future* income distribution on current policies, its results are based on the concavity of an exogenous "transition function" that links agents' current and future incomes and lifts the median voter's expected future income above the mean. Our paper, in contrast, endogenizes the evolution of the income distribution by linking any changes in agents' income position to their rational investment decisions, and it derives a politico-economic equilibrium in which the interdependence between economic decisions and the outcome of the political process is explicitly taken into account.

We present a two-period model in which individuals decide at each point in time whether to make a one-time human capital investment that enables them to earn a higher wage as skilled workers in the modern sector of the economy. While the skilled wage is identical for all workers who have entered the modern sector, the fixed costs differ across individuals, and this may give rise to a situation in which only a minority of the population earns the high wage in period 1. In fact, we assume that a strong majority of agents faces fixed costs above the mean and may therefore have no incentive to enter the modern sector in the first period. The key objective of our paper is to show that this poor majority may nevertheless refrain from expropriating the rich minority because such a policy

would persistently lower the skilled workers' productivity and thus reduce the wage in the modern sector. Hence, even if a majority of agents does not enter the modern sector in period 1, these agents may oppose redistribution in order to maintain the opportunity of earning a higher wage in the future.

The remainder of the paper is structured as follows: in the following section we will present the structure of the model and our assumptions on the economic framework and the political process. In Section 3 we will characterize Nash equilibria for the second period, which we will then use in Section 4 to derive subgame-perfect equilibria of the entire two-period model. In Section 5 we will further investigate the properties of these equilibria by performing comparative statics on crucial parameter values. Section 6 summarizes and concludes.

2 The model

2.1 Basic structure and assumptions

The economy we consider is populated by N agents who consume a homogeneous, non-storable good and live for two periods². In both periods, they can either earn their income as unskilled workers in the "primitive sector" of the economy or as skilled workers in the "modern sector". While the wage in the primitive sector is normalized to zero in both periods, the wage w_t (with $t = 1, 2$) that is paid to skilled workers is strictly positive. Moreover, the skilled wage in the second period is a random variable w_2 with two realizations \bar{w} and \underline{w} , which occur with probabilities π and $(1 - \pi)$, respectively. In order to acquire the skills that are necessary to earn the higher wage, agents have to incur a one-time non-monetary fixed cost which should be interpreted as the disutility of effort associated with the accumulation of human capital. We assume that agents differ in their abilities and that they can be subdivided into two homogeneous groups: those who face high fixed costs $\bar{\theta}$ and those who find it easier to make the investment due to

²The assumption that N is large but finite is important since it implies that agents recognize the effect of their decisions on the outcome of the political process. While our choice to endow agents with mass will make the analysis more tedious in some respects, our modeling strategy has the advantage that it guarantees the existence of an equilibrium for all possible parameter constellations. Since we will later use the expression $0.5N$ we also make the (innocuous) assumption that N is an even number.

lower fixed costs $\underline{\theta}$, with $0 < \underline{\theta} < \bar{\theta}$. There are \underline{n} low-cost agents and \bar{n} high-cost agents, and in order to allow for the possibility that the poor outnumber the rich, we assume that $\underline{n} < 0.5N - 1$, i.e. the high-cost agents represent the majority of the population. Finally, we assume that $\underline{\theta} < \underline{w} < \bar{\theta} < \bar{w}$: the skilled wage always exceeds the fixed cost for the low-cost agents, while for the high-cost agents this only holds if the high realization of w_2 occurs.

Agents can observe the current skilled wage when they decide whether to work in the modern sector or not. However, in the first period they only know the distribution of the future skilled wage. As a result, they may have an incentive to postpone the entry decision and to wait until the uncertainty about w_2 has resolved³. To illustrate this problem, we start by considering the entry decision of agents in a framework without the threat of endogenous redistribution. Assuming that the agents' utility is a linear function of income and effort, i.e. that agents are risk neutral, and that weak preference is sufficient to induce entry into the modern sector, we can state that an agent with fixed costs θ is willing to make the investment in period 1 if

$$w_1 - \theta + \beta E_1(w_2) \geq \beta E_1(\max(w_2 - \theta, 0)), \quad (1)$$

where $E_1(w_2)$ is the expected value of w_2 , conditional on the information available in period 1, and β is the agent's discount factor. The term on the RHS represents the agent's discounted expected utility if the entry decision is postponed: in period 2, the agent will only incur the fixed cost if his net income is non-negative. Otherwise he will stick to unskilled work. For a high-cost agent, the inequality in (1) is equivalent to

$$w_1 + \beta(1 - \pi)\underline{w} \geq (1 - \beta\pi)\bar{\theta} \quad (2)$$

This expression has a straightforward interpretation: The LHS represents the expected additional income from incurring the fixed cost in period 1. This consists of the skilled workers' wage in period 1 and the discounted expected labor income that an agent would *not* earn in period 2 if he postponed the entry decision. The RHS gives the expected additional costs associated with immediate entry: if the

³Note that waiting may be preferable even if the expected net present value of the human-capital investment is positive. Dixit and Pindyck (1994) offer a comprehensive treatment of investment problems under uncertainty in which the option to wait has a positive value.

agent enters the modern sector today, he pays $\bar{\theta}$ with certainty. On the other hand, if he postpones the decision, the discounted expected value of the fixed cost is $\beta\pi\bar{\theta}$. Note that \bar{w} does not appear in (2): if a high-cost agent decides not to exercise his option to invest in the current period, this does not prevent him from entering the modern sector and earning the high wage in the future.

For the low-cost agents, inequality (1) is equivalent to

$$w_1 \geq (1 - \beta)\underline{\theta}. \quad (3)$$

The simplicity of this expression results from our assumption that $\underline{w} > \underline{\theta}$, which implies that in period 2 a low-cost agent will enter the modern sector in any state of nature. Hence, only an extremely low value of w_1 combined with a low discount factor β prevents him from entering in period 1. It is easy to show that (2) implies (3). Hence, if the high-cost agents have an incentive to enter in period 1, this holds a fortiori for the low-cost agents⁴.

2.2 Political process and sequence of events

We assume that, at the end of each period, skilled workers are expropriated if this is strictly preferred by a majority of the population, and we represent the redistributional policy by the variable $R_t \in \{0, 1\}$ with $t = 1, 2$ and $R_t = 1$ if redistribution takes place in period t ⁵. On the other hand, $R_t = 0$ if there is no redistribution at all. In addition, we assume that redistribution persistently lowers the productivity of skilled workers and thus reduces the wage in the modern sector: hence, if $R_1 = 1$, the wage in the modern sector in periods 1 and 2 is reduced by a share $(1 - \nu)$, with $\nu \in (0, 1)$, while if $R_1 = 0$ and $R_2 = 1$, this

⁴To show this, we need to demonstrate that $(1 - \beta\pi)\bar{\theta} - \beta(1 - \pi)\underline{w} \geq (1 - \beta)\underline{\theta}$. This is equivalent to $(1 - \beta)(\bar{\theta} - \underline{\theta}) + \beta(1 - \pi)(\bar{\theta} - \underline{w}) \geq 0$, which is satisfied, given our assumptions on $\bar{\theta}$ and \underline{w} .

⁵In a direct democracy without informational asymmetries, competition among parties guarantees that the policy preferred by the majority is implemented. We are aware that a more realistic description of the political process would take into account that the rich and the poor not only differ with respect to their distributional interests, but also with respect to the means they have to impose these interests and the ability to coordinate their activities. However, the main purpose of this paper is to investigate, under which conditions a majority of poor agents is willing to tolerate a rich minority even if it could dominate the political process, and we conjecture that the crucial forces that drive our results would still be effective if we used a more sophisticated representation of the political process.

Period 1	Period 2
-Realization of w_1	-Realization of w_2
-Investment decisions	-Investment decisions
-Redistribution decision	-Redistribution decision

Figure 1: The sequence of events

only lowers the skilled wage in period 2. What we have in mind by making this assumption is that a policy of radical redistribution comes along with serious frictions that harm the productive process, and that it takes considerable time to reverse this damage. Specifically, we make the following assumption on ν :

Assumption 1 $\nu\bar{w} < \underline{\theta}$

This assumption implies that the post-redistribution wage does not compensate agents for the fixed cost of the human-capital investment, even if the high realization of the skilled wage occurs.

We finally assume that, in case of expropriation, the wage sum in the modern sector is redistributed evenly among the entire population. Hence, if n_t is the number of agents who earn the high wage in period t , the potential per-capita transfer T_t in this period amounts to

$$T_t = \nu w_t n_t / N. \quad (4)$$

In both periods, the resolution of uncertainty, the agents' investment decisions, and the redistribution decision take place in the following order: first, the wage in the modern sector of the economy is realized. Observing this wage, agents simultaneously decide whether to incur the fixed cost and to earn the higher wage paid to skilled workers or to stay in the primitive sector of the economy. At the end of the period, redistribution takes place if it is supported by more than 50 percent of the population. The sequence of events for both periods is presented in Figure 1.

3 The second period

3.1 Redistribution in period 2

We start our analysis by calculating the Nash-equilibria for the subgames that start after the realization of w_2 . At this stage, the history of the game can be summarized by the quadruple (w_2, n_1, q_1, R_1) , where w_2 is the realization of the skilled wage in period 2, n_1 is the total number of agents who have entered the modern sector in period 1, q_1 is the number of high-cost agents who have entered, and R_1 is the result of the political process in period 1⁶. What we are looking for is a vector of participation decisions $S_2 = (S_{12}, \dots, S_{N2})$ where $S_{i2} \in \{0, 1\}$ with $(i = 1, \dots, N)$, and $S_{i2} = 1$ iff agent i chooses to be in the modern sector in period 2. For every subgame, S_{i2} has to maximize the payoff of agent i given the other agents' decisions S_{-i2} . Since an agent's participation decision in period 2 depends on the anticipated outcome of the political process, we will first analyze the determinants of the redistribution decision. In the following subsection, we will then investigate the agents' investment behavior at the beginning of period 2.

The payoff P_{i2}^R of individual i contingent on his and all other agents' entry decisions and the result of the political process at the end of period 2 is given by

$$P_{i2}^R = (1 - R_2) [(1 - R_1)w_2 + R_1\nu w_2] S_{i2} + R_2\nu w_2 \frac{n_2}{N}, \quad (5)$$

where $n_2 = \sum_i S_{i2}$. Equation (5) illustrates that every agent receives a transfer $\nu w_2 n_2 / N$ if $R_2 = 1$, while for $R_2 = 0$ an agent has a positive income iff he works in the modern sector in period 2, i.e. $S_{i2} = 1$. Moreover, this expression reflects our assumption that the skilled wage is persistently lowered if $R_1 = 1$.

Since $\nu w_2 S_{i2} < \nu w_2 n_2 / N$ iff $S_{i2} = 0$ and $n_2 > 0$, it follows from (5) that people strongly prefer redistribution if they are not in the modern sector and if the potential transfer is greater than zero. Moreover, since redistribution takes place if it is preferred by more than 50 percent of the population, we can write

⁶Throughout this paper we do not restrict our attention to symmetric equilibria, which would imply $q_1 \in \{0, \bar{n}\}$, but allow for the possibility that agents of the same type choose different strategies. Whenever this results in multiple equilibria which only differ in the composition of the group of first-period entrants, we do not distinguish these equilibria as long as they are consistent with given values of n_1 and q_1 .

the outcome of the political process in period 2 as a function of the number of second-period skilled workers:

$$R_2(n_2) = \begin{cases} 1 & \text{if } 0 < n_2 < 0.5N \\ 0 & \text{if } (n_2 \geq 0.5N \text{ or } n_2 = 0). \end{cases} \quad (6)$$

3.2 The investment decision in period 2

Having identified the determinants of R_2 , we can now analyze the agents' entry decisions after the realization of w_2 . Taking all other agents' entry decisions as given, and recognizing the potential effect of his own decision on the outcome of the political process, individual i chooses S_{i2} in order to maximize

$$P_{i2}^S = (1 - R_2(n_2)) [(1 - R_1)w_2 + R_1\nu w_2] S_{i2} + R_2(n_2)\nu w_2 \frac{n_2}{N} - \theta_i S_{i2}(1 - S_{i1}), \quad (7)$$

where $S_{i1} \in \{0, 1\}$ is his entry decision in period 1 and θ_i represents the fixed costs incurred by agent i in case of entry. Equation (7) reflects our assumption that if an individual has entered the modern sector in period 1, staying a skilled worker in period 2 is not associated with additional costs. Moreover, since the political decision takes place after the entry decision, an agent who enters the modern sector in period 2 has to bear the fixed cost θ_i regardless of the value of R_2 .

For ease of exposition we make use of

Assumption 2 $\nu \underline{w}(0.5N - 1)/N < \underline{w} - \underline{\theta}$ and $\nu \bar{w}(0.5N - 1)/N < \bar{w} - \bar{\theta}$.

This assumption guarantees that if $0.5N - 1$ individuals work in the modern sector, the $0.5N$ -th potential entrant does not exploit his pivotal position to implement redistribution in period 2⁷.

The following lemma states three results that follow directly from the maximization of (7) and from Assumption 1:

Lemma 1 *i) An agent who chose to enter the modern sector in period 1 stays in the modern sector in period 2: $S_{i1} = 1 \Rightarrow S_{i2} = 1$.*

⁷Assumption 2 considerably simplifies the exposition, but it is not crucial for our results since, as we will show below, there is no equilibrium with $n_1 = 0.5N - 1$.

ii) If $R_2 = 1$ in equilibrium, no additional entry takes place in period 2 (i.e. $n_2 = n_1$).

iii) If $R_1 = 1$, no additional entry takes place in period 2 (i.e. $n_2 = n_1$).

Note that part i) of Lemma 1 in combination with (6) implies that $R_2 = 0$ if $n_1 \geq 0.5N$, i.e., there cannot be a majority in favor of redistribution in period 2 if at least 50 percent of the population have entered the modern sector in period 1.

3.3 Nash equilibria in period 2

We are now ready to present the following conditions which are necessary and sufficient for two different types of Nash equilibria in period 2:

Proposition 1 i) If $R_1 = 0$, an equilibrium in which more than 50 percent of the population support redistribution in period 2 (i.e. $R_2 = 1$) exists, iff $0 < n_1 < 0.5N - 1$ (Condition A) or $n_1 = 0.5N - 1$ and $S_{i1} = 0 \Rightarrow w_2 - \theta_i < 0$ (Condition B).

ii) If $R_1 = 0$, an equilibrium in which at least 50 percent of the population oppose redistribution in period 2 (i.e. $R_2 = 0$) exists, iff $n_1 + \#\{i | S_{i1} = 0, \theta_i \leq w_2\} \geq 0.5N$ (Condition C) or $n_1 = 0$ (Condition D).

iii) If $R_1 = 1$, an equilibrium in which more than 50 percent of the population support redistribution in period 2 (i.e. $R_2 = 1$) exists, iff $0 < n_1 < 0.5N$.

iv) If $R_1 = 1$, an equilibrium in which at least 50 percent of the population oppose redistribution in period 2 (i.e. $R_2 = 0$) exists, iff $n_1 = 0$ or $n_1 \geq 0.5N$.

Proof: i) *Sufficiency:* if Condition A ($0 < n_1 < 0.5N - 1$) is met, there is an equilibrium with $R_2 = 1$ and $n_2 = n_1$, since a majority of the population prefers expropriation and no individual has an incentive to deviate: due to part i) of Lemma 1, the first-period entrants stay in the modern sector. On the other hand, none of the unskilled workers of period 1 has an incentive to enter in period 2: a unilateral deviation would not change the outcome of the political process and due to Assumption 1 the payoff from deviating would be negative. Condition

B refers to the case that $n_1 = 0.5N - 1$ and no further entry takes place because $w_2 < \theta_i$ for all agents who haven't made the investment in period 1. As under Condition A, a majority prefers expropriation and no agent has an incentive to deviate. *Necessity:* we show that if neither Condition A nor Condition B holds, there is no equilibrium with $R_2 = 1$. Neither Condition A nor Condition B is equivalent to $n_1 = 0$, $n_1 \geq 0.5N$, or $n_1 = 0.5N - 1$ combined with the existence of an individual who did not enter in period 1 and for whom $w_2 - \theta_i \geq 0$. If, for $n_1 = 0$, there was an equilibrium with $R_2 = 1$ it follows from part ii) of Lemma 1 that we should have $n_2 = n_1 = 0$, which is a contradiction to $R_2 = 1$, due to (6). If $n_1 \geq 0.5N$, it follows from part i) of Lemma 1 in combination with (6) that $R_2 = 0$. If $n_1 = 0.5N - 1$ and there is an agent with $S_{i1} = 0$ and $w_2 - \theta_i \geq 0$, this individual would prefer to enter the modern sector since his entry would change the outcome of the political process and due to Assumption 2 he would be strictly better off.

ii) *Sufficiency* of Condition C: if apart from the n_1 skilled workers in period 1 every individual with $\theta_i \leq w_2$ enters the modern sector this generates an equilibrium in which a majority of agents opposes redistribution. None of the second period entrants would like to deviate and refrain from investment because the net benefit from deviating would be negative. Condition D: if $n_1 = 0$, there is an equilibrium in which nobody enters in period 2 since a unilateral deviation would trigger redistribution and yield a negative payoff according to Assumption 1. It follows from (6) that this implies $R_2 = 0$. *Necessity:* It follows from (6) that in order to guarantee $R_2 = 0$ it is necessary that either $n_2 \geq 0.5N$ or $n_2 = 0$. For $n_2 \geq 0.5N$ or $n_2 = 0$ in equilibrium it is necessary that either Condition C or Condition D is met. iii) The persistent reduction of the wage rate caused by first-period redistribution prevents further entry in period 2 (see part iii) of Lemma 1). Hence, if $R_1 = 1$, an equilibrium with redistribution in period 2 exists iff $0 < n_1 < 0.5N$. iv) is implied by iii). \square

Note that if $R_1 = 1$ and $0 < n_1 < 0.5N$, the persistent damage caused by expropriation makes the redistribution decision of period 1 persistent, since no individual has an incentive to enter the modern sector in period 2, leaving the majority of the population with an incentive to redistribute. On the other hand, if $R_1 = 0$, the number of high-cost agents who enter the modern sector

in period 1 (q_1) is crucial in determining whether Condition C in part ii) of Proposition 1 is satisfied: if $n_1 < 0.5N$ but $\underline{n} + q_1 \geq 0.5N$, the number of agents who have an incentive to participate in the modern sector in period 2 is at least $0.5N$, regardless of the realization of w_2 . This is due to our assumption that $\bar{w} > \bar{\theta} > \underline{w} > \underline{\theta}$. It follows from the same assumption that if $n_1 < 0.5N$ and $\underline{n} + q_1 < 0.5N$, the number of agents who want to earn the skilled wage in the second period is at least $0.5N$ iff $w_2 = \bar{w}$.

Hence, we can characterize the Nash equilibria of the subgames that start at the beginning of period 2 in terms of the total number of skilled workers (n_2) and the resulting policy decision (R_2). These equilibria depend on the history of the game, namely the realization of the skilled wage in period 2 (w_2), the total number of agents who have entered the modern sector in period 1 (n_1), the number of high-cost agents who have entered (q_1), and the redistribution decision in period 1 (R_1). Tables 1 and 2 survey the Nash equilibria in period 2 contingent on the quadruple (w_2, n_1, q_1, R_1) . Table 1 covers the case that $R_1 = 0$ while Table 2 presents the Nash-equilibria in period 2 for $R_1 = 1$.

(Tables 1 and 2 near here)

Table 1 shows that there are some subgames which are characterized by multiple Nash equilibria: in these cases, an equilibrium in which a majority of agents enters the modern sector and prevents redistribution coexists with a pareto-inferior equilibrium in which there is no additional entry and in which the majority supports redistribution. In what follows we will neglect the second class of equilibria, arguing that agents who are confronted with multiple equilibria recognize the pareto-superior equilibrium in which no redistribution takes place and everybody is better off as a focal point.

4 The first period

4.1 Redistribution in period 1

An agent's expected payoff contingent on the policy decision at the end of period 1 and his own and other agents' preceding entry decisions is given by

$$\begin{aligned} P_{i1}^R &= (1 - R_1) [S_{i1} w_1 + \beta E_1 (SG(S_{i1}, n_1, q_1, 0))] \\ &\quad + R_1 \left[\nu w_1 \frac{n_1}{N} + \beta E_1 (SG(S_{i1}, n_1, q_1, 1)) \right] \end{aligned} \tag{8}$$

where n_1 and q_1 are functions of (S_{11}, \dots, S_{N1}) and $SG(S_{i1}, n_1, q_1, R_1)$ denotes the payoffs associated with the equilibrium outcomes of the subgames in period 2 for an agent who has chosen S_{i1} . Lemma 2 characterizes the political preferences of agents who have entered the modern sector in period 1:

Lemma 2 *An individual who chose $S_{i1} = 1$ opposes redistribution in period 1.*

Proof: For $R_1 = 0$, given n_1 and q_1 , an individual with $S_{i1} = 1$ expects $w_1 + \beta E_1(SG(1, n_1, q_1, 0))$. For $R_1 = 1$ the expected payoff is $(\nu w_1 n_1 / N + \beta E_1(SG(1, n_1, q_1, 1)))$. Since $E_1(SG(1, n_1, q_1, 0)) \geq E_1(SG(1, n_1, q_1, 1))$ and $w_1 > \nu w_1 n_1 / N$ agent i strictly prefers a policy of non-redistribution. \square

Using Lemma 2 and the results of the preceding section, the following proposition describes the outcome of the political process in period 1, contingent on n_1 and q_1 :

Proposition 2 *i) If $n_1 \geq 0.5N$, a majority of the population opposes redistribution in period 1, i.e. $R_1 = 0$.*

ii) If $0 < n_1 < 0.5N$ and $\underline{n} + q_1 \geq 0.5N$, the outcome of the political process in period 1 is determined as follows:

$$R_1(n_1) = \begin{cases} 1 & \text{for } \nu(w_1 + \beta E_1(w_2))n_1/N > \beta(E_1(w_2) - \underline{\theta}) \\ 0 & \text{for } \nu(w_1 + \beta E_1(w_2))n_1/N \leq \beta(E_1(w_2) - \underline{\theta}), \end{cases}$$

and we define

$$\tilde{n}_1(w_1) := \max \{n \in \mathbb{N}_0 \mid \nu(w_1 + \beta E_1(w_2))n/N \leq \beta(E_1(w_2) - \underline{\theta})\}.$$

iii) If $0 < n_1 < 0.5N$ and $\underline{n} + q_1 < 0.5N$, the outcome of the political process in period 1 is determined as follows:

$$R_1(n_1) = \begin{cases} 1 & \text{for } \nu(w_1 + \beta E_1(w_2))n_1/N > \beta \left[\pi(\bar{w} - \bar{\theta}) + (1 - \pi)\nu\underline{w}n_1/N \right] \\ 0 & \text{for } \nu(w_1 + \beta E_1(w_2))n_1/N \leq \beta \left[\pi(\bar{w} - \bar{\theta}) + (1 - \pi)\nu\underline{w}n_1/N \right], \end{cases}$$

and we define

$$\hat{n}_1(w_1) := \max \{n \in \mathbb{N}_0 \mid \nu(w_1 + \beta E_1(w_2))n/N \leq \beta \left[\pi(\bar{w} - \bar{\theta}) + (1 - \pi)\nu\underline{w}n/N \right]\}$$

iv) If $n_1 = 0$, a majority of the population opposes redistribution in period 1, i.e. $R_1 = 0$.

Proof: i) follows directly from Lemma 2. ii): In this case, only a minority of agents has entered the modern sector at the beginning of period 1. However, together with the high-cost agents who have become skilled workers in period 1, the total number of low-cost agents represents a majority. As a consequence, the preferences of the low-cost unskilled workers determine the outcome of the political process in period 1, and they oppose redistribution as long as the benefits from expropriation ($\nu(w_1 + \beta E_1(w_2))n_1/N$) are not greater than the costs in terms of foregone future earning possibilities ($\beta(E_1(w_2) - \underline{\theta})$). Part iii) results from the same logic as ii). However, in this case the high-cost unskilled workers' preferences determine the decision on R_1 , and redistribution is opposed if the option to choose between entry and redistribution in the future is at least as valuable as the transfer income from immediate expropriation. iv): if $n_1 = 0$, expropriation would not yield any positive transfer income today or tomorrow. On the other hand, $R_1 = 0$ leaves agents with the possibility to earn the skilled wage in the future. Hence, $R_1 = 0$ is preferred by a majority of the population. \square

For $0 < n_1 < 0.5N$, Proposition 2 defines two critical values, \tilde{n}_1 and \hat{n}_1 which determine the maximum number of agents that can enter the modern sector in period 1 without triggering redistribution. It is easy to show that both $\tilde{n}_1(w_1)$ and $\hat{n}_1(w_1)$ are decreasing in w_1 ⁸: if w_1 rises, the potential transfer in case of redistribution increases for a given value of n_1 . In order to reduce the relative benefits of redistribution and to support an equilibrium in which the majority of unskilled workers refrains from expropriation in period 1, n_1 has to decrease.

4.2 The investment decision in period 1

In order to characterize the subgame-perfect equilibria (SPE) of the entire game, we finally need a vector of first-period investment decisions $S_1 = (S_{11}, \dots, S_{N1})$ such that for every agent his decision S_{i1} maximizes

$$\begin{aligned} P_{i1}^S &= (1 - R_1(n_1, q_1)) [S_{i1}w_1 + \beta E_1(\text{SG}(S_{i1}, n_1, q_1, 0))] \\ &\quad + R_1(n_1, q_1) [\nu w_1 n_1 / N + \beta E_1(\text{SG}(S_{i1}, n_1, q_1, 1))] - \theta_i S_{i1}, \end{aligned} \quad (9)$$

given the other players' behavior and the outcomes of the subgames described above.

⁸For the time being, we assume that the other parameters which determine \tilde{n}_1 and \hat{n}_1 remain constant, and we therefore write these critical values as functions of w_1 alone.

We assume that N is sufficiently high that a transfer alone does not compensate an agent for the fixed cost he incurs when entering the modern sector:

Assumption 3 $\nu(w_1 + \beta E_1(w_2))/N < \underline{\theta}$.

Assumption 3 guarantees that an agent who anticipates expropriation refrains from entering the modern sector.

Before we start to characterize the different SPE of this game, it is useful to state two important results:

Proposition 3 *There is no equilibrium in which $R_1 = 1$.*

Proof: Suppose that there is an equilibrium with $R_1 = 1$. According to Proposition 2, such an equilibrium requires $n_1 > 0$. However, by using Assumption 3 it is easy to show that each of the n_1 first-period entrants has an incentive to deviate from his original strategy. Hence, there can be no equilibrium with $R_1 = 1$ ⁹. \square

Proposition 3 allows us to neglect the subgames that follow $R_1 = 1$ and to focus on the subgames following $R_1 = 0$ whose equilibrium outcomes are summarized in Table 1. Note, however, that this result does *not* imply that there is a SPE in pure strategies with $R_1 = 0$: to show that such an equilibrium actually exists will be the task of the next subsection.

A similar reduction as in Proposition 3 is brought about by the following lemma¹⁰:

Lemma 3 *There is no equilibrium in which $n_1 = 0.5N - 1$ or $n_1 = 0.5N$.*

Lemma 3 is extremely useful since it states that there is no equilibrium in which a single agent's unilateral deviation would change the outcome of the political process. This allows us to neglect the rows that refer to $n_1 = 0.5N - 1$ in Table 1.

⁹Of course, this strong result hinges on our restriction of the political action space to a choice between 100 percent redistribution and no redistribution at all. If we allowed for a wider range of tax rates, there might be cases in which a certain degree of redistribution takes place in equilibrium. However, we conjecture that the intertemporal considerations that prevent the poor from expropriating the rich in our model would also lower the extent of redistribution in a model with a richer menu of tax rates.

¹⁰The proof can be found in the appendix.

With the help of these results we are now ready to characterize the different SPE of the game. As we will show, there is one equilibrium in which all agents enter the modern sector in period 1, and various "minority equilibria" in which less than 50 percent of the population make the human capital investment in the first period. Given the subject of this paper, the latter class of equilibria is of particular interest, since they represent situations in which the poor outnumber the rich in period 1. As we will show, the majority may nevertheless oppose redistribution since in equilibrium the number of first-period skilled workers does not exceed the boundaries defined in Proposition 2.

4.3 Subgame-perfect equilibria

4.3.1 The majority equilibrium

The following proposition states that there is exactly one equilibrium in which a majority of agents enters the modern sector in period 1. This *majority equilibrium* is characterized by $n_1 = \underline{n} + \bar{n} = N$, that is, the entire population earns the skilled wage in the first period:

Proposition 4 *i) There is no majority equilibrium with $0.5N \leq n_1 < N$.*

ii) An equilibrium with $n_1 = N$ exists iff

$$\begin{aligned} w_1 - \bar{\theta} + \beta E_1(w_2) &\geq \beta\pi(\bar{w} - \bar{\theta}) \\ \Leftrightarrow w_1 &\geq (1 - \beta\pi)\bar{\theta} - \beta(1 - \pi)\underline{w} \equiv \hat{w}_1 \end{aligned}$$

Proof: i): For $n_1 = 0.5N$, the result was already proven in Lemma 3. $0.5N < n_1 < N$ requires that some high-cost agents enter the modern sector in period 1 while a part of the population stays out. However, with $0.5N < n_1$, additional entry would not change the outcome of the political process ($R_1 = R_2 = 0$), and if some high-cost agents have an incentive to make the human-capital investment, the others have so as well. Hence, it would be attractive to deviate for the non-entrants, and therefore $0.5N < n_1 < N$ cannot be an equilibrium. ii): If this condition, which is equivalent to (2), is satisfied, a high-cost agent has an incentive to enter the modern sector, given that $R_1 = R_2 = 0$. As demonstrated above, (2) implies that the low-cost agents enter as well. Hence, the entire population incurs the fixed cost in period 1, and $R_1 = R_2 = 0$ actually holds in equilibrium. \square

Proposition 4 states that the entire population decides to work in the modern sector in period 1 iff w_1 is not smaller than the critical threshold level \hat{w}_1 : in this case, nobody has an incentive to postpone his entry decision, and the expectation that $R_1 = R_2 = 0$ on which this decision is based is consistent with the equilibrium outcome of the political process.

4.3.2 Minority equilibria

Having described the unique majority equilibrium of our model, we will now investigate properties of equilibria where only a minority of the agents enters the modern sector in period 1 (i.e. $n_1 < 0.5N - 1$) but which are nevertheless compatible with $R_1 = 0$. Such a situation represents an equilibrium if those agents who have not yet invested and could expropriate the high-income earners recognize that the costs of redistribution in terms of foregone future earning possibilities are higher than the immediate benefits.

In what follows, we distinguish the case where at least one high-cost agent is in the modern sector in period 1 ($q_1 > 0$) from the case where $q_1 = 0$. The first case is considered in the following Lemma:

Lemma 4 *An equilibrium with $n_1 < 0.5N - 1$, $R_1 = 0$ and $q_1 > 0$ exists only if $w_1 \geq \hat{w}_1$.*

Proof: In a minority equilibrium with $R_1 = 0$ and $q_1 > 0$, a high-cost agent in the modern sector has expected second period utility $\beta(\pi\bar{w} + (1 - \pi)\nu\underline{w}n_1/N)$ or $\beta E_1(w_2)$, depending on $\underline{n} + q_1$ (see Table 1). Hence, the prospects for the second period are never better than those in the majority equilibrium described above. This implies that *ceteris paribus* the first period wage w_1 that induces entry of some high-cost agents must not be smaller than \hat{w}_1 . \square

The above result merely states a necessary condition and does not guarantee the existence of a minority equilibrium with $q_1 > 0$. Deriving sufficient conditions for existence is possible but tedious, and we do not pursue this analysis, since Lemma 4 implies that, if a minority equilibrium with $q_1 > 0$ exists, it always coexists with the pareto-superior majority equilibrium.

It is, however, useful to notice that if a minority equilibrium with $q_1 > 0$ exists for some values of w_1 , it is characterized by $n_1 = \hat{n}_1$ or $n_1 = \tilde{n}_1$ (once

again depending on the equilibrium value of $\underline{n} + q_1$). This is explained as follows: on the one hand, n_1 cannot exceed these boundary values since it follows from Proposition 2 that $\hat{n}_1 < n_1 < 0.5N - 1$ or $\tilde{n}_1 < n_1 < 0.5N - 1$ would induce redistribution in period 1. But n_1 cannot be lower either: if one high-cost agent has an incentive to enter the modern sector in period 1, the others would like to enter as well unless further entry would trigger redistribution. Hence, in equilibrium it must be the case that n_1 just equals the amount that is compatible with $R_1 = 0$. To summarize, we can state that within a subset of $[\hat{w}_1; +\infty)$ there may be minority equilibria with $q_1 > 0$. Although only a minority enters the modern sector in period 1, there is no first period redistribution since n_1 is low enough to make redistribution unattractive for the politically decisive majority. Finally, if such minority equilibria exist, they coexist with the pareto superior majority equilibrium.

The following proposition defines a range of w_1 values that support a minority equilibrium in which *no* high-cost agent enters the modern sector in period 1.

Proposition 5 *i) For $w_1 \in I := [\tilde{w}_1; w'_1)$, where $\tilde{w}_1 \equiv (1 - \beta\pi)\underline{\theta} - \beta(1 - \pi)\nu\underline{w}/N$ and $w'_1 \equiv (1 - \beta\pi)\bar{\theta} - \beta(1 - \pi)\nu\underline{w}/N$, there is a minority equilibrium with only low-cost agents entering the modern sector (i.e. $q_1 = 0$) and with $n_1 = \min\{\underline{n}, \hat{n}_1(w_1)\}$.*

ii) For $w_1 < \tilde{w}_1$ there is an equilibrium with $n_1 = 0$.

Proof: i): For $w_1 \in I$ the low-cost agents prefer to be in the modern sector while no high-cost agent has an incentive to enter. On this interval, the number of skilled workers in period 1 is limited by the total number of low-cost agents (\underline{n}), and by the requirement that $n_1 \leq \hat{n}_1(w_1)$, which guarantees $R_1 = 0$. For the low-cost agents who do not enter the modern sector in period 1, a unilateral deviation yields $\nu(w_1 + \beta E_1(w_2))(\hat{n}_1 + 1)/N - \underline{\theta}$, while sticking to their strategy yields $\beta(\pi(\bar{w} - \underline{\theta}) + (1 - \pi)\nu\underline{w}\hat{n}_1/N)$. That these agents have no incentive to deviate follows from Assumption 3 and the definition of \hat{n}_1 , which implies $\nu(w_1 + \beta E_1(w_2))\hat{n}_1/N + \nu(w_1 + \beta E_1(w_2))/N - \underline{\theta} < \nu(w_1 + \beta E_1(w_2))\hat{n}_1/N \leq \beta(\pi(\bar{w} - \bar{\theta}) + (1 - \pi)\nu\underline{w}\hat{n}_1/N) < \beta(\pi(\bar{w} - \underline{\theta}) + (1 - \pi)\nu\underline{w}\hat{n}_1/N)$. ii): Suppose that $n_1 = 0$: if $w_1 < \tilde{w}_1$, an individual has no incentive to deviate and prefers to postpone the investment decision even if $1 \leq \hat{n}_1(w_1)$. Hence, the interval $[0, \tilde{w}_1)$

supports an equilibrium with $n_1 = 0$. \square

Part i) of Proposition 5 states that for all $w_1 \in I$, the entire group of low-cost agents enters the modern sector in period 1 if $\underline{n} \leq \hat{n}_1$. In this case, the equilibrium is symmetric. On the other hand, a portion of low-cost agents refrains from investing in the first period if $\underline{n} > \hat{n}_1$, since additional entry would trigger redistribution and reduce agents' expected incomes. In this case, there are multiple equilibria which differ with respect to the composition of first-period skilled workers, i.e. with respect to the identity of those low-cost agents who enter the modern sector and those who stay out. However, these situations are identical regarding the total number of first-period entrants n_1 , and they represent situations in which no individual has an incentive to deviate.

Note also that the conditions in Proposition 5 are sufficient, but not necessary for the existence of a minority equilibrium with $q_1 = 0$: such an equilibrium may also exist for some $w_1 \geq \hat{w}_1$. However, in this case the minority equilibrium coexists with the majority equilibrium described above.

4.3.3 The maximum number of skilled workers in period 1

In what follows, we assume that $\bar{\theta}$ is large enough for $\tilde{w}_1 < \hat{w}_1$. A sufficient condition for this is given by:

Assumption 4 $\bar{\theta} > 2\underline{w}$.

Under Assumption 4, there is an interval $[0; \hat{w}_1)$ on which the equilibrium number of first-period entrants is necessarily smaller than $0.5N - 1$. In what follows, we will focus on the maximum number of first-period skilled workers that is feasible in equilibrium conditional on a given first-period wage, and we state our results as a simple corollary to Proposition 5.

Corollary 5.1 *Given Assumptions 1 - 4, the maximum number of skilled workers in the first period in a subgame-perfect politico-economic equilibrium (n_1^{max}) is*

- i) $n_1^{max} = 0$ for $w_1 < \tilde{w}_1$.
- ii) $n_1^{max} = \min\{\underline{n}, \hat{n}_1(w_1)\}$ for $w_1 \in [\tilde{w}_1; \hat{w}_1)$.
- iii) $n_1^{max} = N$ for $w_1 \geq \hat{w}_1$.

Figure 2 illustrates the contents of this corollary and depicts the maximum number of agents who enter the modern sector in period 1 as a function of w_1 : for $w_1 < \tilde{w}_1$, no entry into the modern sector takes place in period 1. On the interval $[\tilde{w}_1, \hat{w}_1)$, only low-cost agents work in the modern sector in period 1, and their number decreases in w_1 ¹¹. As soon as $w_1 \geq \hat{w}_1$, the majority equilibrium becomes feasible, and the maximum number of first-period entrants is given by the size of the entire population.

(Figure 2 near here)

5 Comparative static analysis

So far we have described the different SPE of our model and derived the maximum number of agents that enter the modern sector in period 1. In this section we will analyze how the distribution of w_2 affects the critical values \tilde{w}_1 , \hat{w}_1 and the boundary $\hat{n}_1(w_1)$.

Increasing π , that is, raising the probability that the high realization of w_2 occurs, obviously lowers \hat{w}_1 and expands the interval on which the majority equilibrium is feasible. Making use of Assumption 1, it is easy to show that increasing π also lowers the threshold value \tilde{w}_1 . Finally, the value of $\hat{n}_1(w_1)$ increases in π , i.e., the brighter the prospects on future earnings, the higher the number of low-cost agents that may enter the modern sector in period 1 without triggering redistribution. This is due to the fact that raising π implies both a higher probability that the high-cost individuals will become skilled workers in the future and a higher expected wage in the modern sector. Hence, it improves the "prospect of upward mobility" for unskilled workers and thus increases the costs of a redistributive policy in period 1. On the other hand, we have $\hat{n}_1(w_1) = 0$ for all w_1 if $\pi = 0$: without the perspective of entering the modern sector in the future, the majority of high-cost agents does not hesitate to expropriate a rich minority in period 1, even if this policy causes persistent damage. Our model thus suggests that high inequality does not automatically result in massive redistribution if agents are sufficiently optimistic about the future, and it thus explains the

¹¹In drawing Figure 2, we have assumed that $0 < \hat{n}_1(w_1) < \underline{n}$ for all $w_1 \in [\tilde{w}_1, \hat{w}_1)$ and we have neglected the fact that $\hat{n}(w_1)$ should actually be drawn as a step function.

stylized facts presented by Hirschman (1973)¹².

What is the effect of a mean-preserving increase in risk on the values of \hat{w}_1 , \tilde{w}_1 and $\hat{n}_1(w_1)$? Lowering \underline{w} by the amount Δ while increasing \bar{w} by $(1 - \pi)\Delta/\pi$ increases the variance of w_2 while keeping its expected value constant¹³. This raises both \hat{w}_1 and \tilde{w}_1 : the lower w_2 in the unfavorable state of nature, the greater the incentive to postpone the entry decision until the uncertainty about w_2 has resolved. Note, however, that the upward shift of \hat{w}_1 is stronger than the upward shift of \tilde{w}_1 , with the latter being negligible if N is very large. Hence, increasing Δ both shifts and expands the interval $[\tilde{w}_1; \hat{w}_1]$. On the other hand, a mean-preserving increase in risk raises $\hat{n}_1(w_1)$ for all values of w_1 , since it raises the costs of redistribution in terms of foregone potential future income. These findings suggest that countries which are characterized by high economic volatility are more likely to end up in the minority equilibrium and that economic instability is related to political instability through the effect of income uncertainty on agents' investment decisions: according to our model, the evolution of an economy that is subject to large fluctuations is characterized by high inequality and a sizeable chance of redistributive policies.

6 Summary and conclusions

This paper has offered a theoretical explanation for the observation that in most countries there is no radical redistribution of income although the majority of the population earns wages well below the economy-wide average. We have shown that there are politico-economic equilibria in which a majority of agents is willing to tolerate a minority of high-income earners although immediate redistribution would increase their current income. On one hand, this result is due to our assumption that redistributive policies cause an irreversible damage and thus persistently reduce the wage of skilled workers. However, persistence alone is not enough, since it only matters if, without redistribution, the currently poor can expect to earn a higher income in the future: only if there is a realistic chance of upward mobility do the costs of redistribution outweigh the immediate benefits,

¹²Note, however, that unlike Hirschman, we do not assume that the current income distribution provides some information on future income prospects

¹³In doing this, we need to make sure that our assumptions $\bar{w} > \bar{\theta} > \underline{w} > \underline{\theta}$ and $\nu\bar{w} < \underline{\theta}$ are not violated.

and this prevents the poor majority from expropriating the rich.

In presenting this argument, we have not relied on exogenous shifts of the income distribution. Instead, we have linked the evolution of agents' relative income positions to their investments in human capital and explicitly modeled the interdependence between agents' investment decisions and the outcomes of the political process. What made our analysis nontrivial despite the simple setup was the requirement to guarantee optimality of agents' behavior and consistency of rational expectations with the actual path of endogenous economic policy¹⁴.

We have shown that future earning possibilities not only decide on the feasibility of a minority equilibrium, but also determine the maximum number of agents who may earn the higher wage in the first period without triggering redistribution. Moreover, we have demonstrated that greater uncertainty about future incomes - reflected by a mean-preserving increase in the variance of skilled wages - makes it more likely that only a minority of the population enters the modern sector in the first period. However, raising the variance of wages also increases the maximum number of agents who may become skilled workers without triggering redistribution. Hence, our model suggests that macroeconomic volatility both spurs growth and fuels latent distributional conflicts.

Finally, our implications are roughly in line with Kuznets' (1955) observation of an inverse U-shaped relationship between economic development and inequality: in our model, first-period inequality is low both at low and at high levels of per-capita income, since the entire population either postpones the entry decision or makes the investment. At intermediate income levels, however, wage differences are high since only a minority of the population earns the skilled wage.

7 References

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¹⁴Krusell et al. (1997) offer a discussion of the problems that arise in this kind of models.

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8 Appendix

Proof of Lemma 3:

Suppose that there is an equilibrium with $n_1 = 0.5N - 1$: according to Proposition 3, $R_1 = 0$ in equilibrium. Additionally, we must have $0 < q_1 < \bar{n}$, that is, some (but not all) high-cost agents enter the modern sector in period 1. To prevent high-cost agents who enter in period 1 from deviating, it must be the case that $w_1 - \bar{\theta} + a(n_1, q_1) \geq b(n_1 - 1, q_1 - 1)$ where $a(x, y)$ denotes the expected second period utility of a high-cost skilled worker, given that the total number of skilled workers in period 1 is x and the number of high-cost skilled workers is y , and $b(x, y)$ denotes the expected utility of a high-cost agent who does not enter the modern sector in period 1. On the other hand we need $w_1 - \bar{\theta} + \beta E_1(w_2) < b(n_1, q_1)$ to prevent further entry. An equilibrium with $n_1 = 0.5N - 1$ would require that $a(n_1, q_1) - \beta E_1(w_2) + b(n_1, q_1) - b(n_1 - 1, q_1 - 1) > 0$. Using our previous results, we will show that this cannot be satisfied.

Case 1 Suppose that in equilibrium $\underline{n} + q_1 \geq 0.5N$: in this case, $a(n_1, q_1) - \beta E_1(w_2) = 0$ and $b(n_1, q_1) = \beta\pi(\bar{w} - \bar{\theta})$. On the other hand $b(n_1 - 1, q_1 - 1) = \beta\pi(\bar{w} - \bar{\theta})$ for $\underline{n} + q_1 - 1 \geq 0.5N$, and $b(n_1 - 1, q_1 - 1) = \max\{\beta\pi(\bar{w} - \bar{\theta}) + \beta(1 - \pi)\nu\underline{w}(n_1 - 1)/N; \nu(n_1 - 1)(w_1 + \beta E_1(w_2))\}$ for $\underline{n} + q_1 - 1 < 0.5N$. Combining these two parts, we get $a(n_1, q_1) - \beta E_1(w_2) + b(n_1, q_1) - b(n_1 - 1, q_1 - 1) \leq 0$ which contradicts the condition above. **Case 2** $\underline{n} + q_1 < 0.5N$: In this case, $a(n_1, q_1) - \beta E_1(w_2) = -\beta(1 - \pi)(1 - \nu n_1/N)\underline{w}$ while $b(n_1, q_1) - b(n_1 - 1, q_1 - 1) = \beta(1 - \pi)\nu\underline{w}/N$. So $a(n_1, q_1) - \beta E_1(w_2) + b(n_1, q_1) - b(n_1 - 1, q_1 - 1) < 0$ as $(1 - \nu n_1/N) > \nu/N$ for $n_1 = 0.5N - 1$.

The proof for $n_1 = 0.5N$ follows exactly the same logic and we omit it. \square

			n_2	R_2
$n_1 = 0$		$w_2 = \underline{w}$	0	0
		$w_2 = \overline{w}$	a) $\underline{n} + \overline{n}$ b) 0	a) 0 b) 0
$0 < n_1 < 0.5N - 1$	$q_1 + \underline{n} \geq 0.5N$	$w_2 = \underline{w}$	a) $q_1 + \underline{n}$ b) n_1	a) 0 b) 1
		$w_2 = \overline{w}$	a) $\underline{n} + \overline{n}$ b) n_1	a) 0 b) 1
	$q_1 + \underline{n} < 0.5N$	$w_2 = \underline{w}$	n_1	1
		$w_2 = \overline{w}$	a) $\underline{n} + \overline{n}$ b) n_1	a) 0 b) 1
$n_1 = 0.5N - 1$	$q_1 + \underline{n} \geq 0.5N$	$w_2 = \underline{w}$	$q_1 + \underline{n}$	0
		$w_2 = \overline{w}$	$\underline{n} + \overline{n}$	0
	$q_1 + \underline{n} < 0.5N$	$w_2 = \underline{w}$	n_1	1
		$w_2 = \overline{w}$	$\underline{n} + \overline{n}$	0
$n_1 \geq 0.5N$		$w_2 = \underline{w}$	$\underline{n} + q_1$	0
		$w_2 = \overline{w}$	$\underline{n} + \overline{n}$	0

Table 1: Second period Nash equilibria for $R_1 = 0$

	n_2	R_2
$n_1 = 0$	0	0
$0 < n_1 < 0.5N$	n_1	1
$n_1 \geq 0.5N$	n_1	0

Table 2: Second period Nash equilibria for $R_1 = 1$

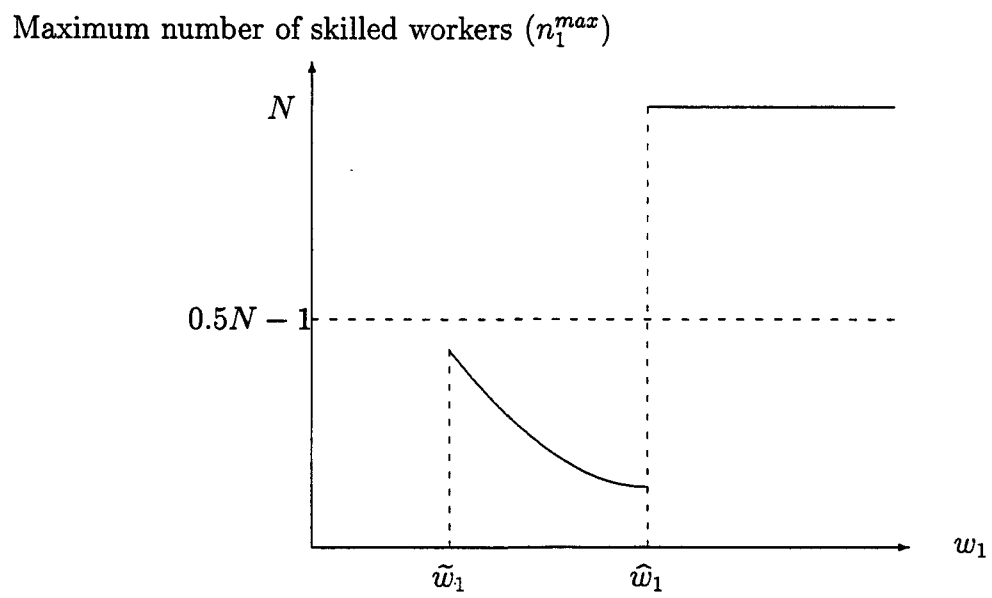


Figure 2: The maximum number of skilled workers in period 1