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Abstract

The proportion of college graduates in the United States labor force increased steadily after 1970. On the other hand, skill premium decreased during the 1970s but it increased during the 1980s and the 1990s. The law of demand and supply explains the decrease in the skill premium during the 1970s. Why did skill premium increase during the 1980s and the 1990s? This paper develops a novel economic growth theory, in which the level of education affects economic outcomes through economic institutions and policies. The model suggests that the increase in the proportion of college graduates in the United States labor force in the 1970s may have been a causal factor in both the decline in the college premium during the 1970s and the large increase during the 1980s and the 1990s. I argue that the proportion of skilled workers in the labor force determines their relative importance in the political process. Thus, the increase in the proportion of skilled workers during the 1970s reduced skill premium in the short run, but induced a change in policies that increased the skill premium in the subsequent decades above its initial value.

Key Words: Economic Growth, Economic Institutions, Economic Policies, Wage Inequality, Education, Skill Premium.

JEL Codes: I24, I25, J31, O43.

I. INTRODUCTION

In the period after 1970 economic fortunes diverged, especially in the United States. Middle and high income Americans have continued to benefit from the rapid economic growth, but material well-being for the lower income classes has stagnated. Households with an annual income of over $100,000 (year 2000 dollars) increased from under 3% in 1967 to over 12% in 2000. In year 2000 dollars, median income increased from $31,400 in 1967 to $42,200 in 2000. Although overall inequality increased steadily after 1970, this was not the case for skill premium. In 1970 college graduates earned 55% more than high school graduates. This premium fell to 41% in 1980, but then it increased to 62% in 1995.[1] Also, the relative supply of skills increased rapidly after the late 1960s in the United States because of the Vietnam War draft laws and the increase in government support for education.[2]

One explanation for the rapid increase in the college premium in the 1980s and the 1990s is skill biased technological change.[3] According to this explanation, an increase in the supply of skills has two effects on skill premium. First, it decreases skill premium through the conventional substitution effect which makes the economy move along a downward sloping relative demand curve. Second, it increases skill premium through the directed technology effect which shifts the relative demand for skills because the increase in the supply of skills induces faster upgrading of skill-complementary technologies. Galor and Moav (2000) argue that an increase in the rate of technological progress raises the returns to ability and simultaneously generates an increase in wage inequality between and within groups of skilled and unskilled workers and an increase in education. Finally, there is the international trade explanation, which states that an increase in the volume of trade increases the demand for skilled labor in advanced countries. As a result, both the supply of skills and the skill premium increase.[4]

[1] See Autor, Katz, and Krueger (1998). Also, about inequality and its relationship with economic growth see Alesina and Rodrik (1994), Alesina and Perotti (1996), Galor et al. (2009), Galor and Moav (2004), Gould et al. (2001), and Persson and Tabellini (1994).
[2] According to Barro and Lee (2010) the increase in the proportion of college graduates between 1970 and 2000 was approximately 15 percentage points higher in the United States than in the Western European countries.
[3] See Acemoglu (1998, 2003).
[4] See Dinopoulos and Segerstrom (1999), and Acemoglu (2003).

This paper provides another explanation that works through economic institutions and policies. Fortin and Lemieux (1997), and Hacker and Pierson (2011) argue that this is probably the main explanation because technical change and increased international trade are expected to similarly affect every advanced country, but the evolution of skill premium after 1970 was not the same in every advanced country.[5] Evidence shows that skill premium increased sharply in the United States; however, there was less of an increase in the U.K. and almost no change in most continental European economies.[6]

Economic institutions determine the incentives of economic actors and shape economic outcomes. As such, they are social decisions chosen for their consequences. Different groups and individuals benefit from different economic institutions and policies. Thus, there exists a conflict over these social choices, ultimately resolved in favor of groups with greater political power. An increase in the number of skilled individuals will increase their political power and their ability to affect economic policies. Economists agree that economic institutions and policies are determined endogenously. McCarthy et al. (2006) argue about the changes in economic policy that took place during the 1980s: "Reagan conservatism was a product sitting on a shelf in the political supermarket. In 1980, customers switched brands". As the number of those who benefit from conservative economic policies increased dramatically during the 1970s, both parties, and not only the Republicans, adopted relatively more conservative economic policies. McCarthy et al. (2006) argue that both the Democrats and the Republicans became more conservative in economic issues after 1975. Gerring (1998) argues that after the 1970s Democrats have moved their platforms away from general welfare issues to issues based on ascriptive characteristics, such as race and gender, of individuals.

The basic argument is as follows: low-educated voters are not willing or able to fully understand the impact the various policies have on their income. As a result, they rely on advertisement in order to decide which policies will benefit them more. This gives an incentive to political parties to choose inefficient policies that benefit some groups, in exchange for campaign contributions

[5] Fortin and Lemieux (1997) examine the effect of economic institutions on wage inequality but they assume that economic institutions are exogenous. Hacker and Pierson (2011) examine mainly the increased inequality between the top 1% and the rest of the population. They argue that inequality increased because the top 1% controls the government. The effect of the increase of the level of education on economic institutions and policies is not part of their explanation.

[6] See Freeman and Katz (1995), Katz et al. (1995), and Nickell and Bell (1996).

that 'buy' unskilled workers' votes. Inefficient policies (low property right protection, high tax on profits, high cost to start a new firm, high minimum wage, etc) imply smaller support from educated voters and bigger support from uneducated voters. An increase in the proportion of skilled workers in the labor force implies an increase in the relative importance of skilled workers in the political process. As a result, an increase in the proportion of skilled workers reduces skill premium in the short run, but then it induces a change in economic policies that increases the skill premium, possibly even above its initial value.

Empirical evidence supports the conjecture that economic institutions and policies can account for much of the rise in dispersion of the wage distribution. Several papers examine the effect of the level of the minimum wage on wage inequality. More specifically, DiNardo et al. (1996) find that from 1979 to 1988 the decrease in the minimum wage explains 24% (for men) and 32% (for women) of the change in the variance in log wages. Card and Krueger (1995) conclude that 20 to 30 percent of the rise in wage dispersion during the 1980s could be attributed to the decline in the real value of the minimum wage. Mishel et al. (1996) examine the 90/10 wage differential and report even larger effects. Lee (1999) finds that during the 1980s, the estimates for men, women, and the combined sample, imply that almost all of the growth in the wage gap between the tenth and fiftieth percentiles is attributable to the erosion of the real value of the minimum wage during the decade. Also, he argues that the minimum wage may account for as much as 80% of the growth in the so called 'within-group' wage inequality and about 15% of the change in the return to schooling during the 1980s.

This paper argues that the main reason why political parties choose such inefficient policies is not to gain support from unskilled workers through redistribution, but to benefit some special interest groups in exchange for campaign contributions.[7] Indeed, Neumark et al. (2004) argue that low-wage workers are adversely affected by minimum wage increases. Although wages of low-wage workers increase, their hours and employment decline, and the combined effect of these changes is a decline in earned income. They also find that relatively low-wage union members gain at the expense of the low-wage nonunion workers when minimum wages increase.

[7] Alesina et al. (2001) show empirically that higher inequality is not associated with more redistribution. This implies that the traditional model of the median voter who chooses the level of redistribution is not a good representation of reality. I don't argue here that there is no redistribution. The assumption is that at least some policies that reduce skilled workers' income are chosen in order to benefit some special interest groups.

This explains the vigorous support of labor unions for minimum wage increases and their significant contributions to the political campaigns.[8] Labor market regulations, high taxes, corruption, and restrictions, which increase the cost of starting a firm are some other policies that negatively affect skilled workers more than unskilled. Labor unions, corrupt bureaucrats, and firms that target government subsidies, are among those who prefer high tax rates and a large, inefficient government, thus making them supporters of these policies.[9]

The assumption that unskilled individuals are impressionable voters is at the heart of the model. Impressionable voters are those who are not willing or are not able to make the calculations necessary for strategic voting. Those voters pay attention to campaign advertisement. Therefore, the more a party spends (holding constant the spending of its rival), the greater is its share of the impressionable votes. Strategic voters understand the political environment and the implications of their votes. By voting for the party whose platform he prefers, a strategic voter slightly increases his expected welfare. There is empirical evidence that education increases civic participation.[10] Educated individuals participate more actively in politics, read newspapers more often, send letters to politicians, and try to persuade others. Also, education allows those who are interested in politics to understand and evaluate the different policies and the impact that these policies have on their welfare. In other words, education allows individuals to become strategic voters.[11]

The impact of an increase in the supply of skills on the skill premium is determined by two competing forces: the first is the conventional *substitution effect* which makes the economy move along a downward sloping relative demand curve. The second is the *political economy effect*, which shifts the relative demand curve for skills as shown in Figure I, because the increase in the supply of skills induces policy changes that benefit skilled workers. A large increase in the supply of college graduates as in the late 1960s and 1970s first moves the economy along a short-run (constant policy) relative demand curve, reducing the college premium. The increase in the relative supply of skills also increases the fraction of strategic voters and decreases the

[8] According to Hrebenar et al. (1999), both in the 1995-1996 and in the 1997-1998 campaign cycles, five out of the top ten political action committee (PAC) contributors to federal candidates are labor unions.
[9] For the negative effect of corruption on growth see Mauro (1995) and Murphy et al. (1993).
[10] See Dee (2004), Glaeser, Ponzetto, and Shleifer (2007), and, Milligan, Moretti, and Oreopoulos (2004).
[11] A similar assumption has been made by Bourguignon and Verdier (2000). They argue that only those with high enough education vote. I argue that only those with high enough education are strategic voters.

fraction of impressionable voters. Thus, policies gradually change, through the political process, and skill premium increases. The relative demand curve in Figure I shifts to the right. If the political economy effect is not big enough then the skill premium first falls and then increases, but not above its initial level. In contrast, if the political economy effect is big enough, the model predicts that in the long run the college premium should increase. This case (shown in Figure I) explains the change in the U.S. college premium after 1970.

II. THE MODEL

A. Production

There is a sequence of discrete time periods $t = 1,2, \ldots$ There is a mass L of workers in the economy. Workers can be skilled (entrepreneurs) or unskilled. I assume that the number of skilled and unskilled workers is exogenous. Later I will relax this assumption. There are s skilled and u unskilled individuals that supply labor inelastically. Individuals live forever and for simplicity I assume that they cannot save or borrow. In the end of each period they consume all their income, and thus they seek to maximize it.

People consume only one good, called the final good, which is produced by perfectly competitive firms using as inputs unskilled labor and a continuum of intermediate goods according to the technology:[12]

$$Y_t = u^{1-\alpha} \int_0^1 A_{it}^{1-\alpha} x_{it}^{\alpha} di, \tag{1}$$

where each x_{it} denotes the quantity of intermediate input i used in final good production at time t, and A_{it} is a productivity parameter that reflects the current quality of the intermediate good i. The coefficient α lies between zero and one. In any period the productivity parameters will vary across intermediate products because of the randomness of the innovation process.

Each intermediate good is produced by a monopolist each period, using the final good as all input, one for one. That is, for each unit of intermediate good, the monopolist must use one unit

[12] This model is based on Aghion and Howitt (1992, 2009).

of final good as input. Final good that is not used for intermediate production is available for consumption.

Each monopolist at t maximizes her profit measured in units of the final good:

$$\Pi_{it} = p_{it}x_{it} - x_{it} \tag{2}$$

where p_{it} is the price of the intermediate good i relative to the final good.

The inverse demand curve facing each monopolist charging the price p_{it} is the marginal product:

$$p_{it} = \alpha(A_{it}u)^{1-\alpha}{x_{it}}^{\alpha-1} \tag{3}$$

Therefore, the monopolist in sector i chooses the quantity x_{it} to maximize profits,

$$\Pi_{it} = (\alpha(A_{it}u)^{1-\alpha}{x_{it}}^{\alpha-1} - 1)x_{it} \tag{4}$$

which implies an equilibrium quantity:

$$x_{it} = \alpha^{\frac{2}{1-\alpha}}A_{it}u \tag{5}$$

The equilibrium profit of the monopolist is:

$$\Pi_{it} = (1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}A_{it}u \tag{6}$$

In each period, entrepreneurs (skilled individuals) will attempt an innovation, each one in a different sector. If an entrepreneur succeeds, the innovation will create a new version of the intermediate good, which is more productive than previous versions and the successful entrepreneur will have the exclusive right to produce and sell this version of the intermediate good for one period. Specifically, the productivity of the intermediate good will go from last period's value $A_{i,t-1}$ up to $A_{it} = \gamma A_{i,t-1}$, where $\gamma > 1$. If she fails, then there will be no innovation and the intermediate good will be the same one that was used in $t-1$, so $A_{it} = A_{i,t-1}$.

In order to innovate, the entrepreneur must conduct research, a costly activity that uses entrepreneur's labor as its only input. The probability that an innovation occurs in any period t is:

$$\mu_{it} = \lambda \frac{\varphi A_t}{A_{it}^*} \tag{7}$$

where $A_{it}^* = \gamma A_{i,t-1}$ is the productivity parameter if she succeeds. The reason why the probability of innovation depends on A_{it}^* is that as technology advances it becomes more complex and thus harder to improve upon. λ is a parameter that reflects the productivity of the research sector. Entrepreneurial skills are produced by two inputs: time and local knowledge. I take as given the amount of time spent in education by each entrepreneur.[13] Local knowledge is a public input which I assume to be proportional to aggregate productivity $A_t = \int_0^1 A_{it} di$. φA_t is the skill level of each entrepreneur.[14]

Each entrepreneur's wage is her expected reward from innovation:

$$w_s = \lambda \frac{\varphi A_t}{A_{it}^*} \Pi_{it} = \lambda \frac{\varphi A_t}{A_{it}^*} (1-\alpha) \alpha^{\frac{1+\alpha}{1-\alpha}} A_{it} u = \lambda \varphi A_t (1-\alpha) \alpha^{\frac{1+\alpha}{1-\alpha}} u \tag{8}$$

because $A_{it}^* = A_{it}$ when innovation takes place. Equation (8) implies that the expected reward is the same in all sectors.

Each unskilled worker will receive his marginal product:

$$w_u = (1-\alpha) \alpha^{\frac{2\alpha}{1-\alpha}} A_t \tag{9}$$

Skill premium, ω, is defined as follows:

$$\omega = \frac{w_s}{w_u} = \lambda \varphi \alpha u = \lambda \varphi \alpha (L - s) \tag{10}$$

I assume for simplicity that $L = 1$ and thus, s is the share and the number of skilled workers. Skill premium becomes:

$$\omega = \lambda \varphi \alpha (1 - s) \tag{11}$$

[13] It is straightforward to endogenize the time spent on education. Suppose that $\varphi = (1-n)n^m$ represents the effective supply of skills, where n is the time spent in education and m lies between zero and one. Each entrepreneur chooses the same n in order to maximize φ.

[14] The same assumption is made by Howitt and Mayer-Foulkes (2005). They assume that the skill level depends on the average level of technology.

B. *Political economy model*

There are two political parties, A and B. Each party announces before the election the set of policies that will implement if elected. To simplify the analysis I restrict the available policies to those that affect directly only the profit of a successful innovator.[15] Such policies are, for example, efforts to reduce corruption and protect property rights, the cost to start a new firm, labor market regulations like the minimum wage, etc.[16] The outcome of each set of policies is a tax rate, τ, such that τ is the total fraction of the profits that the owner of each firm loses because of corruption, labor market regulations, etc.[17]

This tax rate affects directly the wage of skilled workers (and their relative wage, or skill premium). The wage becomes:

$$w_s = \lambda \frac{\varphi A_t}{A_{it}^*}(1-\tau)\Pi_{it} = (1-\tau)\lambda\varphi A_t(1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}u \tag{12}$$

And the skill premium:

$$\omega = (1-\tau)\lambda\varphi\alpha(1-s) \tag{13}$$

There are, also, two special interest groups, SIG_A and SIG_B. Members of each group are all the economic agents that receive rents when party A and B respectively wins the election. If an economic agent receives rents from both political parties then this agent is member of both interest groups. Members can be the firms that receive part of the total tax revenue as a subsidy, the bureaucrats who benefit from the corruption that the government allows, the labor unions that receive contributions from their members who benefit from the higher minimum wage and other labor market regulations, etc. I assume that both special interest groups are small enough such that there is no coordination cost and no free riding.

[15] These policies affect directly the wage of strategic voters. All other policies that this paper does not consider affect only unskilled workers. The assumption that policies that affect unskilled workers are exogenous is based on the basic assumption of the model that impressionable voters do not take into account the proposed policies when they vote.

[16] Benabou (2005) uses a similar way, through a unique tax rate, to represent the set of public policies like taxes and transfers, minimum wage laws, firing costs, etc.

[17] Note that this set of policies determines the wage *before* income taxes which is also the marginal product of skilled labor.

The timing of events is the following: first, the two parties announce their set of policies. Then, each SIG announces its contribution to its party, and finally election takes place.[18] Also, I assume that after a party announces its policy, it cannot change it and it is committed to implement it, if elected.

Voters maximize the following utility:

$$U_j = {f_j}^{\alpha} c^b \tag{14}$$

Where c is consumption (each individual consumes all her income), and f_j depends on the political ideology of the specific individual, j, and on the political ideology of each party. Also, $0 < a < 1$ and $0 < b < 1$.

There are two types of voters: strategic and impressionable.[19] According to Grossman and Helpman (2001), "strategic voters understand the political environment and the implications of their votes". On the other hand, "impressionable voters rely on campaign ads". Grossman and Helpman (2001) assume that the share of strategic and impressionable voters is exogenous. I assume that the level of education affects people's willingness and ability to make the calculations necessary for strategic voting.[20] The assumption here is that policies are complicated and their effect on people's income is difficult to calculate. Individuals with high enough education are willing and able to make these calculations and, thus, they know exactly how a specific policy will affect them. Political advertisement has no effect on them. In other words, the assumption is that political advertisement will not make them change their mind once they know the policy that each party is willing to adopt. Individuals with relatively low education are not willing or are not able to make the necessary calculations and, thus, they don't know how a specific policy will affect them. Political advertisement affects their decision. If the amount of advertisement is bigger for one of the parties, this party will attract more impressionable voters.

[18] This timing of events implies that SIG will not contribute money to influence policies. In order for this to happen, SIG should contribute before the party announces its policy. In this paper, SIG give their contributions after the parties announce their policies. Thus, SIG have only electoral motive. See Grossman and Helpman (2001) for a detailed discussion about influence motive and electoral motive. This choice of the timing of events does not affect the main results of the model; it only makes the analysis simpler.

[19] The analysis and the model presented here are based on Baron (1994) and Grossman and Helpman (1996, 2001).

[20] There is evidence that education affects civic participation. See Dee (2003), Glaeser, Ponzetto, and Shleifer (2007), and, Milligan, Moretti, and Oreopoulos (2004).

For simplicity, I assume that skilled individuals have high enough education and they are strategic voters, while unskilled individuals are impressionable voters.

Strategic voter's j utility is:

$$U_{\iota j}^{S} = (f_{\iota j})^{a}(w_s(\tau_\iota))^{b}, \tag{15}$$

where $\iota = A, B$ denotes party A and B.

Strategic voter j chooses party A if: $f_{Aj}^{a} c_A^{b} \geq f_{Bj}^{a} c_B^{b} \rightarrow \frac{f_{Bj}}{f_{Aj}} \leq (\frac{w_s(\tau_A)}{w_s(\tau_B)})^{\frac{b}{a}}$. Where $f_j = \frac{f_{Bj}}{f_{Aj}}$ is the relative popularity of party B for voter j. I assume that f_j is uniformly distributed with mean z.[21] Also: $c_\iota = w_s(\tau_\iota)$, shows that consumption is equal to the wage, and that the wage depends on the set of policies, τ_ι.

The share of votes for party A among strategic voters is:

$$V_A^{S} = \frac{1}{2} - z + \left(\frac{w_s(\tau_A)}{w_s(\tau_B)}\right)^{\frac{b}{a}}, \tag{16}$$

where z shows the relative popularity of party B's fixed position. If $z = 1$, then the two parties are equally popular and, thus, if they choose the same policies, each will get 50% of the votes.

Impressionable voters' utility is:

$$U_\iota^{u} = (f_\iota)^{a}(Ew_u(\tau_\iota))^{b}, \tag{17}$$

where $\iota = A, B$ denotes party A and B.

Impressionable voters cannot estimate the effect of the policy on their income. They form expectations with respect to this effect:

$$Ew_u(\tau_\iota) = (D_\iota)^{\beta}, \tag{18}$$

D_ι is the contribution of SIG_ι to party ι. This is also the amount that this party will spend on advertising. $\beta > 0$ is a parameter measuring the effectiveness of the campaign spending.

[21] Grossman and Helpman (1996, 2001) assume uniform distribution, too. The choice of the uniform distribution does not affect the main results. It just makes the analysis much simpler.

Impressionable voter j chooses party A if: $f_{Aj}^{a}(D_A^{\beta})^b \geq f_{Bj}^{a}(D_B^{\beta})^b \rightarrow \frac{f_{Bj}}{f_{Aj}} \leq (\frac{D_A}{D_B})^{\frac{\beta b}{a}}$, where $f_j = \frac{f_{Bj}}{f_{Aj}}$ is the relative popularity of party B for voter j. Again, f_j is uniformly distributed with mean z. This means that the popularity of the fixed position (ideology) of the two parties is the same among strategic and impressionable voters.

The share of votes of party A among impressionable voters is:

$$V_A^u = \frac{1}{2} - z + \left(\frac{D_A}{D_B}\right)^{\frac{\beta b}{a}} \tag{19}$$

And the total share of votes for party A is:

$$V_A = V_A^s s + V_A^u(1-s) = \frac{1}{2} - z + \left(\frac{w_s(\tau_A)}{w_s(\tau_B)}\right)^{\frac{b}{a}} s + \left(\frac{D_A}{D_B}\right)^{\frac{\beta b}{a}} (1-s) \tag{20}$$

And so:

$$V_A = \frac{1}{2} - z + \left(\frac{(1-\tau_A)\lambda\varphi A_t(1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}u}{(1-\tau_B)\lambda\varphi A_t(1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}u}\right)^{\frac{b}{a}} s + \left(\frac{D_A}{D_B}\right)^{\frac{\beta b}{a}} (1-s), \text{ and} \tag{21}$$

$$V_A = \frac{1}{2} - z + \left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s + \left(\frac{D_A}{D_B}\right)^{\frac{\beta b}{a}} (1-s), \tag{22}$$

where s is the fraction of skilled individuals and, thus, the fraction of strategic voters, and $(1-s)$ is the fraction of unskilled individuals and, thus, the fraction of impressionable voters. Also, again individuals consume all their income,

$$c = w_s = (1-\tau)\lambda\varphi A_t(1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}u.$$

The probability that $V_A \geq \frac{1}{2}$, that is, the probability that party A wins the election is equal to the probability that $z \leq \left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s + \left(\frac{D_A}{D_B}\right)^{\frac{\beta b}{a}} (1-s)$. z is a random variable and $F()$ is its distribution function. The probability that party A wins the election, P_A, is equal to:

$$P_A = F(\left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s + \left(\frac{D_A}{D_B}\right)^{\frac{\beta b}{a}} (1-s)) \tag{23}$$

Given D_B, τ_A and τ_B (remember that first parties announce their policies and then SIG choose their contributions), SIG_A will choose D_A in order to maximize its expected net benefit:

$$B_A = P_A(D_A)\zeta\tau_A\pi - D_A \tag{24}$$

Where $P_A(D_A)$ is the probability that party A wins the election when its contribution is D_A, and $\zeta\tau_A\pi$ is the total net benefit from the set of policies, τ_A, for SIG_A. π is the maximum total profit that all the monopolists could earn if $\tau_A = 0$, and ζ lies between zero and one and captures the deadweight loss.[22]

The FOC is the best response function for SIG_A:

$$F'(\left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s + \left(\frac{D_A}{D_B}\right)^{\frac{\beta b}{a}} (1-s)) \frac{\frac{\beta b}{a} D_A^{\frac{\beta b}{a}-1}}{D_B^{\frac{\beta b}{a}}} (1-s)\zeta\tau_A\pi = 1 \tag{25}$$

Similarly for SIG_B:

$$B_B = P_B(D_B)\zeta\tau_B\pi - D_B, \tag{26}$$

where $P_B = 1 - P_A$.

The FOC is:

$$F'(\left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s + \left(\frac{D_A}{D_B}\right)^{\frac{\beta b}{a}} (1-s)) \frac{\frac{\beta b}{a} D_A^{\frac{\beta b}{a}}}{D_B^{\frac{\beta b}{a}+1}} (1-s)\zeta\tau_B\pi = 1 \tag{27}$$

The two FOCs imply:

$$\frac{D_A^*}{D_B^*} = \frac{\tau_A}{\tau_B} \tag{28}$$

Finally, party A will choose τ_A to maximize its share of votes:

[22] I assume here that the members of each special interest group receive a fraction of the amount that firms lose because of the policy. The rest is the deadweight loss. The more realistic model with deadweight loss that is proportional to the square of the 'tax' is presented in the appendix. The two approaches give different policies in equilibrium, but they predict a very similar effect of the supply of skills on skill premium.

$$V_A = \frac{1}{2} - z + \left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s + \left(\frac{\tau_A}{\tau_B}\right)^{\frac{\beta b}{a}} (1-s) \tag{29}$$

The FOC which is also the best response function for party A is:

$$\frac{b(1-\tau_A)^{\frac{b}{a}-1}}{a(1-\tau_B)^{\frac{b}{a}}} s = \frac{\beta b(\tau_A)^{\frac{\beta b}{a}-1}}{a(\tau_B)^{\frac{\beta b}{a}}} (1-s) \tag{30}$$

Party B maximizes:

$$V_B = 1 - V_A = \frac{1}{2} + z - \left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s - \left(\frac{\tau_A}{\tau_B}\right)^{\frac{\beta b}{a}} (1-s) \tag{31}$$

The FOC is:

$$\frac{b(1-\tau_A)^{\frac{b}{a}}}{a(1-\tau_B)^{\frac{b}{a}+1}} s = \frac{\beta b(\tau_A)^{\frac{\beta b}{a}}}{a(\tau_B)^{\frac{\beta b}{a}+1}} (1-s) \tag{32}$$

The two first order conditions imply:

$$\tau_A^*(s) = \tau_B^*(s) = \tau^*(s) = \frac{\beta(1-s)}{s+(1-s)\beta} \tag{33}$$

PROPOSITION 1. Both political parties choose the same policy (tax rate), $\tau^*(s) = \frac{\beta(1-s)}{s+(1-s)\beta}$ which is a decreasing function of the supply of skills and an increasing function of the effectiveness of the political campaign, β.

Proof. Follows from the differentiation of $\tau^*(s)$ with respect to s and β.

Thus, economic institutions and policies can be expressed as a function of the proportion of skilled workers.

C. *The effect of the supply of skills on skill premium*

Remember that skill premium, ω, and also the relative demand for skilled labor is:

$$\omega = (1-\tau)\lambda\varphi\alpha(1-s) \tag{34}$$

It can be easily derived that, if the level of economic institutions, τ, is exogenous (in which case we have the short run relative demand for skilled labor, i.e. the demand for skilled labor before economic institutions and policies adjust, after an exogenous change in the relative supply of skills) then an increase in the share of skilled workers will reduce skill premium:

$$\frac{\partial\omega}{\partial s} = -(1-\tau)\lambda\varphi\alpha < 0$$

This implies that the short run relative demand is always downward sloping. Given the demand for skilled labor, an increase in the supply of skilled labor will result to a lower skill premium.

Things are very different when the amount of skilled labor affects the level of economic institutions (long run). In this case, skill premium becomes:

$$\omega = (1-\tau^*(s))\lambda\varphi\alpha(1-s) \tag{35}$$

where: $\tau^*(s) = \frac{\beta(1-s)}{s+(1-s)\beta}$

The total effect of an exogenous change of the proportion of skilled workers is the following:

$$\frac{\partial\omega}{\partial s} = [(1-\tau^*(s))\frac{\partial(\lambda\varphi\alpha(1-s))}{\partial s}] + [-\frac{\partial\tau^*(s)}{\partial s}(\lambda\varphi\alpha(1-s))] \tag{36}$$

where $\frac{\partial\tau^*(s)}{\partial s} = -\frac{\beta}{(\beta(1-s)+s)^2} < 0$

The total effect is decomposed into two effects: the first, the *substitution effect*, is the one described above and is negative. The second, the *political economy effect*, is positive, and it is coming from the fact that the amount of skilled labor affects the level of economic institutions and policies, and through them, the returns to skilled labor. In other words, the supply of skilled labor affects the demand for skilled labor.

More specifically, the first term of the right hand side of equation (36), is always negative and shows the decrease in skill premium right after an increase in the relative supply of skills. This captures the short run response (see Figure II) and it is simply the movement along the short run demand curve (in the short run, $\frac{\partial \tau^*(s)}{\partial s} = 0$). On the other hand, the second term is always positive and shows the increase in skill premium in the long run caused by the institutional improvement that the increase in the relative supply of skills induces. In Figure II this is shown by the shift to the right of the short run demand curve.

If the first term is greater than the second, then the total effect is negative:

$$\frac{\partial \omega}{\partial s} = [(1 - \tau^*(s)) \frac{\partial(\lambda \varphi \alpha (1-s))}{\partial s}] + [-\frac{\partial \tau^*(s)}{\partial s}(\lambda \varphi \alpha (1-s))] < 0 \quad (38)$$

In this case, the positive effect from institutional improvement is lower than the negative market effect.

If the second term is greater than the first, then the total effect is positive.

$$\frac{\partial \omega}{\partial s} = [(1 - \tau^*(s)) \frac{\partial(\lambda \varphi \alpha (1-s))}{\partial s}] + [-\frac{\partial \tau^*(s)}{\partial s}(\lambda \varphi \alpha (1-s))] > 0 \quad (39)$$

This case, shown in Figure II, is consistent with what was observed in the U.S. during the 70s, the 80s, and the 90s.

The above analysis is summarized in the following proposition:

PROPOSITION 2. Short run and long run relative demand for skills:

a. The short run relative demand for skills,

$$\omega_{SR}(s) = \frac{w_s}{w_u} = (1 - \tau)\lambda \varphi \alpha (1 - s)$$

is always downward sloping. The skill premium always decreases right after an exogenous increase in the relative supply of skills.

b. The long run relative demand for skills:

$$\omega_{LR}(s) = \frac{w_s}{w_u} = (1 - \tau^*(s))\lambda \varphi \alpha (1 - s) = \frac{s\lambda \varphi \alpha (1-s)}{s + (1-s)\beta}$$

is upward sloping when:

$$0 \leq s < \frac{\sqrt{\beta}}{1+\sqrt{\beta}} < 1$$

and it is downward sloping when:

$$0 < \frac{\sqrt{\beta}}{1+\sqrt{\beta}} < s \leq 1$$

For sufficiently low values of s, skill premium increases in the long run after an exogenous increase in the relative supply of skills.

Proof. See appendix

III. ENDOGENOUS SUPPLY OF SKILLS

In the previous section the supply of skilled and unskilled labor was exogenous. In this section, I assume that education choices are forward looking and respond to returns. Of course, there can still be exogenous changes in the supply of skills caused for example by a change in the quality of education, the cost of education, etc.

I assume that in the beginning of every period workers must become reeducated in order to qualify as skilled workers with the new generation of technology.[23] If an individual decides to become educated, he or she will receive the wage of the skilled worker, w_s. The cost of education is proportional to the skilled wage, $\sigma \nu_h w_s$, where σ is a subsidy on education or simply the quality of education.[24] When the quality of education is higher, σ is low, then the cost of education is lower. We could think of this cost as a time cost. If the quality of education is higher, then a worker will spend less time in order to become skilled. $\nu_h \geq 0$ is a random variable that captures the heterogeneity among individuals caused by different ability or credit constraints. Lower values of ν_h imply higher ability. If an individual chooses to remain uneducated, he or she will receive w_u.

[23] An alternative assumption could be that the economy is populated by dynastic families and that each family has one member that lives only one period, so that every period a new member replaces the old. The new member must decide to become skilled or unskilled worker.

[24] The result does not change if the cost of education is proportional to the unskilled wage or to a weighted average of skilled and unskilled wage.

An individual h will become skilled if: $w_s - \sigma v_h w_s \geq w_u$, which implies that all individuals with $v_h \leq \frac{\omega-1}{\sigma\omega}$ will choose to become skilled. The fraction of skilled workers is $s = G(\frac{\omega-1}{\sigma\omega})$, where $G()$ is the distribution function of v_h, and ω is the skill premium. This function represents the supply of skills. Under the assumption that v_h is uniformly distributed in $[0,1]$, the supply function becomes: $s = \frac{\omega-1}{\sigma\omega}$.

The relative supply curve is shown in Figure III. As expected, it is upward sloping. A decrease in the cost of education, or an increase in the quality of education shifts the relative supply curve to the right. All the results presented above, in the model with the exogenous supply of skills, hold here as well.

Figure III shows that when the quality of education is high enough there are three equilibria: the first at $s = 0$ is stable, the second, s_1, is unstable and the third, s_2, is stable. The economy will end up in the third equilibrium only if initially the relative supply of skills is sufficiently high, $s > s_1$. If initially the relative supply of skills is lower than this critical point, then the economy will remain in a poverty trap. Low education levels will make beneficial for the political parties to choose inefficient policies that create economic rents, and these policies will offer poor incentives for investment and innovation. This explains why poor democracies with low levels of education cannot escape stagnation.[25] Special interests capture the government and extract rents through policies that keep the country poor because there is no sufficient number of voters that is vigorously willing to support growth promoting policies.

IV. DISCUSSION

The main contribution of this paper is that it provides a new theoretical explanation for the evolution of the skill premium in the United States after 1970. The proportion of college graduates in the United States labor force increased steadily after 1970. On the other hand, skill premium decreased during the 1970s but it increased during the 1980s and the 1990s. The law of

[25] For other theories that explain how countries can escape poverty and why some countries are not successful and remain far below the leader see Acemoglu (2001), Azariadis (1996), Azariadis and Drazen (1990), Basu and Weil (1998), Galor and Zeira (1993), Galor and Tsiddon (1997), Galor (2011) and Galor and Weil (1999, 2000).

demand and supply explains the decrease in the skill premium during the 1970s. Why did skill premium increase during the 1980s and the 1990s? In other words, why did the relative demand for skills increase during the 1980s and the 1990s? Acemoglu (1998) argues that because of the increase in the number of college graduates, after 1980 new technologies have been designed mainly to complement skilled labor. Galor and Moav (2000) argue that the increase in the rate of technological progress after 1970 increased the demand for skilled labor because skilled individuals are more able to adapt and remain productive when the technology advances quickly. Dinopoulos and Segerstrom (1999) argue that the increase in the volume of trade increased the demand for skilled labor in advanced countries. This paper argues that the increase in the proportion of college graduates increased their relative importance in the political process. As a result, economic institutions and policies changed after 1980 in a way that benefits mainly skilled workers.

Second, this paper develops an economic growth model in which education affects economic outcomes not only directly, but also indirectly through economic institutions and policies. Existing economic growth theories argue that education directly affects economic outcomes in two ways: a) Education (human capital) is an additional accumulating factor of production.[26] Mankiw et al. (1992) develop a neoclassical economic growth model and they argue that education increases the growth rate during the transition toward the steady state. Lucas (1988) develops an AK model and argues that education increases the steady state rate of growth. b) Education affects a country's ability to innovate or to catch up with more advanced countries.[27] Nelson and Phelps (1966) distinguish between the growth of the technology frontier and the growth of total factor productivity. They argue that the former depends on the speed of innovations while the latter depends on the implementation of these innovations. They also argue that the rate of implementation depends on the level of education. In other words, an increase in the level of education increases the growth rate because it allows faster technology diffusion. This research argues that education also affects economic outcomes indirectly, through the political process. An increase in the level of education increases people's ability and willingness to understand how the various policies affect their income. As a result, an increase in the level of education leads to pro-growth policies.

[26] See Becker (1964) and Mincer (1974)
[27] See Nelson and Phelps (1966), and Benhabib and Spiegel (1994, 2005).

Finally, this paper is one of the first attempts to develop an economic growth model with endogenous economic institutions and policies.[28] Most economic growth models assume that policies are exogenous. As a result, they cannot provide a complete answer to the question ‘‘why some countries are rich while others are poor?”. Their answer is that rich countries are the ones that adopt growth enhancing policies. However, in most cases they do not explain why some countries adopt growth enhancing policies while others do not. This paper combines economic growth theory and political economy theory in order to show how economic policies are determined, how they evolve during the process of development and how they affect this process.

More specifically, it argues that there are three distinct groups in every democracy: individuals with low education, individuals with high education, and the elite. People have the power to choose their leaders and through them the policies they prefer, but not everyone is acting as a strategic voter. Strategic voting implies that voters are willing and able to make the calculations that are necessary in order to evaluate the effect that policies have on their welfare.[29] To a large extent, economic institutions and policies, for example the level of corruption, can be determined endogenously through the political process. If all voters were strategic then there wouldn’t be any democracies with bad, for economic growth, economic institutions and policies (there are several examples in South America and Africa). The level of education affects the probability that an individual is a strategic voter, and the political conflict is mainly between the voters with high enough education (middle class) and the political elite (and those who have access to it). This doesn’t mean that voters with low education (the working class) do not participate in politics. The relative political power of the elite is positively correlated with the proportion of these voters. The elite can use its influence and money in order to ‘buy’ the support of these voters. The level of education determines the allocation of the political power between the middle class and the elite, and the allocation of the political power determines the quality of economic institutions and policies.[30]

[28] See also Acemoglu (2006).
[29] There is empirical evidence that the political economy models that treat all voters as strategic are not a good representation of reality. See, for example, Alesina et al. (2001).
[30] Galor and Moav (2006) examine the role of the struggle between the social classes, too.

V. CONCLUDING REMARKS

This paper develops an economic growth model with endogenous economic institutions and policies and provides a new theoretical explanation for the observed pattern of the supply of skills and the skill premium in the United States after 1970. It argues that the rapid increase of the supply of skills after 1970 reduced the skill premium in the short run, but then it induced a change in policies which increased skill premium after 1980, above its initial value.

There are several interesting areas for future research. First, the model developed here can be used in order to revisit some important economic growth questions. For example, this model can help examine why income differences persist even among countries that have escaped stagnation. In other words, why is income in Western European countries persistently lower than that in the United States? Preliminary work suggests that countries that innovate more (e.g. the United States) have more human capital than countries that innovate less (e.g. Western European countries), even if the two groups of countries use similar technologies, because the demand for human capital is higher in innovation than in imitation. As a result, in the first group of countries the proportion of strategic voters is greater, voters choose better for growth policies, and therefore, income differences between the two groups persist.

Second, this paper assumes that there is a simple two-party system. It would be interesting to develop a model with more than two political parties. A multi-party system represents better the reality in many poor countries with significant ethnic, linguistic and religious fractionalization. In such a model we could examine, among others, whether the level of education a country needs in order to escape stagnation in a multiparty system is higher or lower compared to a two-party system. This analysis might help us understand further under which channels fractionalization affects economic growth. Finally, it would be interesting to develop a model with endogenous economic institutions and policies in non-democratic regimes.

VI. APPENDIX

A. *Deadweight loss from taxation that is proportional to the square of the tax rate.*

This appendix examines the case in which the deadweight loss from the policies is proportional to the square of the 'tax' rate. In this case special interest groups receive $\left(\tau - \frac{1}{2}\tau^2\right)\pi$ instead of $\zeta\tau\pi$.

SIG_A maximizes:

$$B_A = P_A(D_A)(\tau_A - \tfrac{1}{2}\tau_A^2)\pi - D_A,$$

and SIG_B maximizes:

$$B_B = (1 - P_A(D_B))(\tau_B - \tfrac{1}{2}\tau_B^2)\pi - D_B.$$

The two first order conditions imply:

$$\frac{D_A^*}{D_B^*} = \frac{\tau_A - \frac{1}{2}\tau_A^2}{\tau_B - \frac{1}{2}\tau_B^2}$$

Party A will choose τ_A to maximize its share of votes:

$$V_A = \frac{1}{2} - z + \left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s + \left(\frac{\tau_A - \frac{1}{2}\tau_A^2}{\tau_B - \frac{1}{2}\tau_B^2}\right)^{\frac{\beta b}{a}} (1-s)$$

The FOC which is also the best response function for party A is:

$$\frac{b(1-\tau_A)^{\frac{b}{a}-1}}{a(1-\tau_B)^{\frac{b}{a}}} s = \frac{\beta b(1-\tau_A)(\tau_A - \frac{1}{2}\tau_A^2)^{\frac{\beta b}{a}-1}}{a(\tau_B - \frac{1}{2}\tau_B^2)^{\frac{\beta b}{a}}} (1-s)$$

Party B maximizes:

$$V_B = 1 - V_A = \frac{1}{2} + z - \left(\frac{1-\tau_A}{1-\tau_B}\right)^{\frac{b}{a}} s - \left(\frac{\tau_A - \frac{1}{2}\tau_A^2}{\tau_B - \frac{1}{2}\tau_B^2}\right)^{\frac{\beta b}{a}} (1-s)$$

The FOC is:

$$\frac{b(1-\tau_A)^{\frac{b}{a}}}{a(1-\tau_B)^{\frac{b}{a}+1}}s = \frac{\beta b(1-\tau_B)(\tau_A-\frac{1}{2}\tau_A^2)^{\frac{\beta b}{a}}}{a(\tau_B-\frac{1}{2}\tau_B^2)^{\frac{\beta b}{a}+1}}(1-s)$$

The two first order conditions give only one solution for τ that lies between zero and one. This is the same for both political parties:

$$\tau^*(s) = \frac{2\beta(1-s)+s-\sqrt{s(2\beta+s-2\beta s)}}{2\beta(1-s)+s}$$

The long run relative demand for skill becomes:

$$\omega_{LR}^*(s) = \left(1-\frac{2\beta(1-s)+s-\sqrt{s(2\beta+s-2\beta s)}}{2\beta(1-s)+s}\right)\alpha\lambda\varphi(1-s)$$

The equation $\frac{\partial\omega_{LR}^*(s)}{\partial s}=0$ has only one solution that lies between zero and one, $\forall\beta\in\left(0,\frac{1}{2}\right)\cup(\frac{1}{2},\infty)$:

$$s^* = \frac{3\beta-\sqrt{\beta(4+\beta)}}{4\beta-2}$$

Also, L'Hospital's rule implies:

$$\lim_{\beta\to\frac{1}{2}^-}\frac{3\beta-\sqrt{\beta(4+\beta)}}{4\beta-2} = \lim_{\beta\to\frac{1}{2}^+}\frac{3\beta-\sqrt{\beta(4+\beta)}}{4\beta-2} = \frac{1}{3}$$

Again, when $s<s^*$, the long run relative demand for skills is upward sloping, while when $s>s^*$, the long run relative demand for skills is downward sloping.

B. *Proof of Proposition 2.*

a. Follows from the differentiation of $\omega_{SR}(s)$ with respect to s.

b. The derivative of $\omega_{LR}(s)$ with respect to s is: $\frac{\partial\omega_{LR}(s)}{\partial s}=\frac{\alpha\varphi\lambda(\beta(s-1)^2-s^2)}{(\beta+s-\beta s)^2}$. Set it equal to zero and solve for s: $s_1^*=-\frac{\sqrt{\beta}}{1-\sqrt{\beta}}$ and $s_2^*=\frac{\sqrt{\beta}}{1+\sqrt{\beta}}$. For $\beta>0$, $s_1^*\in(-\infty,0)\cup(1,+\infty)$, and $s_2^*\in(0,1)$. The derivative of $\omega_{LR}(s)$ with respect to s is positive when $s=0<s_2^*$. Thus, the relative demand for skills is upward sloping when $0\le s<s_2^*<1$ and downward sloping when $0<s_2^*<s\le 1$.

C. *Figures*

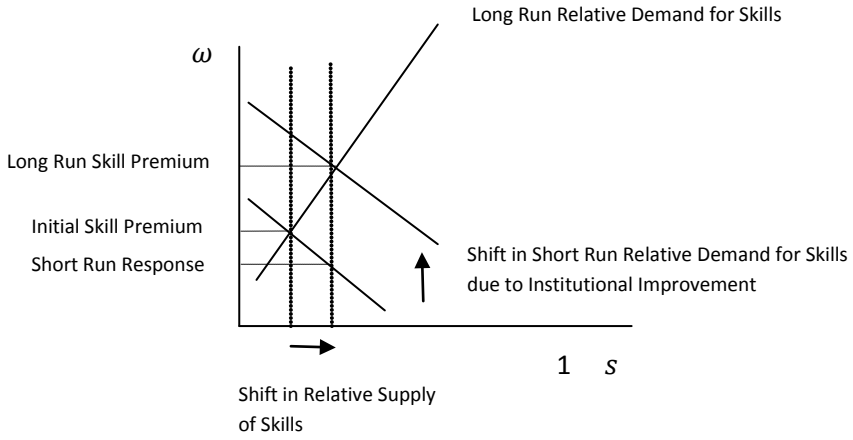

Figure I

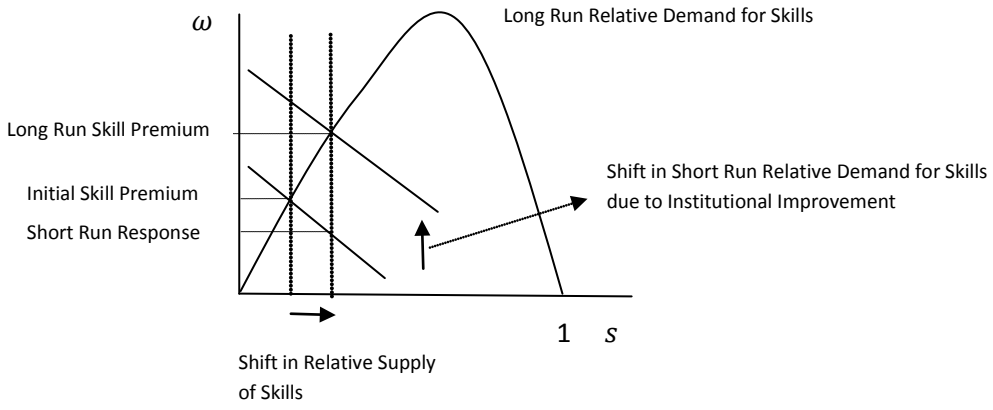

Figure II

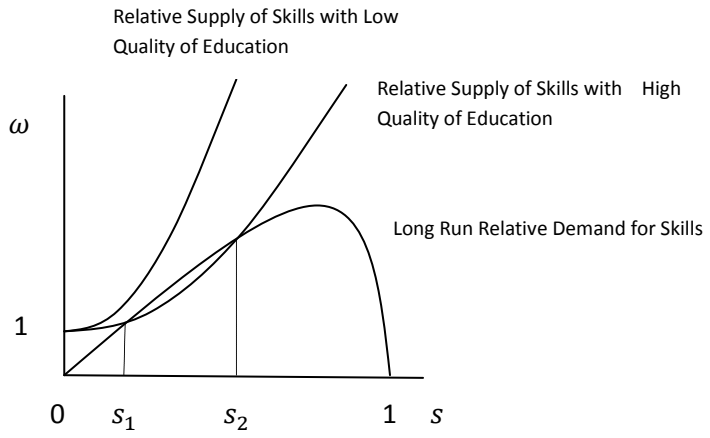

Figure III

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