Optimal Technology, Development and the role of Government

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Abstract

This paper highlights the effect of the presence of the goverment and its redistribution policy in the technology adoption decision. As a result it helps explain the differences in skill premium patterns across the North Atlantic between developed economies such as the US and Continental Europe.

1. Introduction

When comparing the performance between the US and Continental Europe in terms of skill premium, Acemoglu (2003) argues that three mechanisms are responsible for the differences in technology adoption and skill premium across the North Atlantic.

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- First he argues that the supply of skilled workers has behaved differently in Europe vs.. the US. The relative supply of skilled workers has increased faster in Europe than in the US.

- Second, the institutions in Europe compress the skill premium. The wage setting environment in Europe is much more concerned with inequality than that of the US, and therefore differences in the performances in terms of skill premium are influenced by the differences in institutions.

- Finally, the demand also behaved differently, being the demand for skilled workers in the US much stronger than that of Europe.

Acemoglu (2003) proposes a model where firms choose different technologies given the labor market conditions and finds that it helps explain the differences across the North Atlantic Ocean. In particular he argues that the third reason stated above plays an important role in accounting the differences for these countries. On the other hand, in a somewhat related article, Prescott (2004), argues that differences in the labor supply between Continental Europe and the US are mostly related to differences in tax rates.

Moscoso Boedo (2006) develops a general equilibrium dynamic model that incorporates the first and third arguments stated above. In that work I find that the skill premium by 1990 in the 1st decile of the distribution for GDP per worker is lower than that of the US, and that is entirely explained by the differences in the paths of T.F.P. The US experienced a much faster growth in T.F.P and therefore a abrupt adoption of technologies intensive in skilled workers. This steeper transition generated an evolution of skill premium in the US that is above its counterpart in Europe.[1]

In this paper, I incorporate a government to the model. In the case of the OECD countries we have access to the OECD Tax Database with data for tax rates for the different levels of wage rates together with the levels of capital taxation, which, in general, it is not available for a large number of countries.

The focus of this paper is to understand the differences across OECD countries in a framework where the three elements outlined by Acemoglu (2003) are relevant. That is, skills are created and supplied to the market, skills are demanded by firms that have a technological decision and where the government taxes differently across income levels. The main mechanism in the model will be the following: conditional on different tax rates for skilled and unskilled workers, the households will supply different stocks of skilled and unskilled workers together with physical capital. On the firms side, they will adopt different technologies that vary in terms of the skill intensity. The focus will be on the effects of the government taxation and transfers on the production of skills and adoption of different technologies. Basically, the effect of government policies can be divided in two: first, the different tax rates affect the returns to skills and therefore act as incentives or disincentives to the creation of skills, and second, the transfers that the households receive from the government act as endowment, influencing the skill creation.

In addition to the international comparison in steady state, the introduction of taxes to the model enables me to run policy experiments. Basically, I will simulate the effects

[1] In Moscoso Boedo (2005), there are two aspects of the model that may not be suitable for the analysis of developed countries analysis. First, the definition of skilled worker. There the definition is that of a worker with primary schooling. For a comprehensive cross country analysis I was "forced" to pick that definition because on the lower end of the output per worker spectrum, countries would have gotten a very low level of supply of skilled workers. But for the analysis of developed countries it seems much more appropriate to denote skilled workers to those with more than secondary school complete.

of taxes similar to those observed in the US since 2001 and evaluate what the model predicts.

The paper is organized as follows: In section 2 a theoretical model is presented. There I use the basic model presented by Moscoso Boedo (2006) in its decentralized version with the inclusion of a very simple government that taxes differently the various sources of income. Section 3 presents the data used to calibrate and evaluate the model, section 4 explains the calibration procedure and section 5 uses the model to investigate the effects of taxes in the behavior of skill premium and technology choices across countries. Section 6 investigates the dynamic effects of changes in the tax code as those introduced in the US in 2001. Finally, section 7 concludes.

2. Model

This will be based on Moscoso Boedo (2006), with the introduction of the government. Where the production technology is an endogenous choice subject to accelerated obsolescence in the case of a technology change.

Households

A set of atomistic representative households own capital and labor. They rent capital, skilled labor and unskilled labor to the firm every period The capital and skilled labor they own is of type b and can only be used in production in a type b firm. They make investment and education decisions. Education is undertaken internally in the household[2]. That means that the household decides how much capital, skilled labor and unskilled labor supply to the market given prices, and the part of capital, skilled labor and unskilled labor that is not supplied is used to produce more skilled labor for

[2] This is not a key issue. Households could buy $H()$ in the market since it is a constant returns to scale technology the results would not change.

next period. Every period the type of the physical capital and skills the household owns is given but can be changed for the future, so the household not only chooses the evolution of the quantity of physical capital and skilled labor but also its type for the future.

So, the problem of the representative consumer can be written as follows

$$\max_{C_t, I_t, S_{p_t}, U_{p_t}, K_{p_t}, S_{e_t}, U_{e_t}, K_{e_t}, b_{t+1}} \sum_{t=0}^{\infty} \beta^t u\left(C_t\right) \tag{2.1}$$

subject to

$$\begin{aligned}
C_t + I_t &\leq \left(1 - \tau_{s_t}\right) w_{s_{b_t}} S_{p_t}\left(b_t\right) + \left(1 - \tau_{u_t}\right) w_{u_{b_t}} U_{p_t} + \left(1 - \tau_{k_t}\right) r_{b_t} K_p\left(b_t\right) \\
&\quad + Tr_t \\
S_t\left(b_t\right) &\geq S_{p_t}\left(b_t\right) + S_{e_t}\left(b_t\right) \\
U_{p_t} + U_{e_t} &\leq 1 - S_t\left(b_t\right) \\
K_t\left(b_t\right) &\geq K_{p_t}\left(b_t\right) + K_{e_t}\left(b_t\right) \\
S_{t+1}\left(b_{t+1}\right) &\leq S_t\left[1 - \delta_s - G\left(b_t, b_{t+1}\right)\right] + H\left(K_{e_t}\left(b_t\right), S_{e_t}\left(b_t\right), U_{e_t}\right) \\
K_{t+1}\left(b_{t+1}\right) &\leq K_t\left[1 - \delta_k - G\left(b_t, b_{t+1}\right)\right] + I_t
\end{aligned}$$

Where C_t, I_t denote consumption and investment in period t respectively. S_{p_t}, U_{p_t} and K_{p_t} denote skilled workers, unskilled workers and capital devoted to final production and S_{e_t}, U_{e_t} and K_{e_t} denote skilled workers, unskilled workers and capital into education. b_t indexes the technology active in the final production sector in period t. $w_{s_{b_t}}, w_{u_{b_t}}$ and r_{b_t} stand for wages for skilled workers, unskilled workers and interest rate in period

t under technology b. Taxes are denoted by τ_{s_t}, τ_{u_t} and τ_{k_t} where subscript s denotes taxes on skilled workers, u taxes on unskilled workers and k taxes on capital income. The household will also be entitled to a transfer by the government which will be taken as given and is denoted by Tr_t.

Finally we have two functions that will be discussed in more detail below, but $G(b_t, b_{t+1})$ is used to express the accelerated obsolescence of skills and physical capital as a result of a technology change, and the function $H(K_{e_t}(b_t), S_{e_t}(b_t), U_{e_t})$ is the education function, that is, the function that is used to create skills.

Note that the household supplies to the market only one type of both skills and physical capital and the household pays the price in terms of obsolescence when choosing what type to supply.

Firms

Final goods producing firms can be ordered according what technology they operate, by the parameter b. Firms operate for one period, that is they have a static problem. They rent unskilled labor, skilled labor and capital of type b from the household in order to maximize profits. In other words in every period there is demand for unskilled labor, skilled labor and capital of every type b, $0 < b < 1$. The market under which firms operate is perfectly competitive. So problem each firm of type b solves is:

$$\max_{S_{p_t}(b), U_{p_t}, K_{p_t}(b)} \quad p_t F(b, K_{p_t}(b), S_{p_t}(b), U_{p_t}) - w_{s_t}(b) S_{p_t}(b) - w_{u_t}(b) U_{p_t} - r_t(b) K_{p_t}(b)$$

So the optimal conditions for each type b firm are:

$$\begin{aligned} \frac{w_{s_t}(b)}{p_t} &= F_{S_p}\left(b, K_{p_t}(b), S_{p_t}(b), U_{p_t}\right) \\ \frac{w_{u_t}(b)}{p_t} &= F_{U_p}\left(b, K_{p_t}(b), S_{p_t}(b), U_{p_t}\right) \\ \frac{r_t(b)}{p_t} &= F_{K_p}\left(b, K_{p_t}(b), S_{p_t}(b), U_{p_t}\right) \end{aligned} \tag{2.2}$$

Where $w_{s_t}(b)$ stands for wages for skilled workers offered by a firm operating technology b in period t, $w_{u_t}(b)$ stands for wages for unskilled workers offered by a firm operating technology b in period t and $r_t(b)$ represents the interest rate offered by firms operating technology b in period t. And p_t stands for the price of final goods, which is normalized to 1. So, for every b-type firm, their maximizing behavior determines wages and interest rate under each technology. Therefore at every moment in time we have a function of wages and interest rate as function of the parameter b.

Note that firms in the model play a very uninteresting role. They can also be interpreted as freely choosing the any production parameter $b \in [0, 1]$, where it is necessary to hire K_p and S_p of that type in order to produce final goods.

Government

The government will have a very passive role in the model. It will only collect taxes and redistribute income through transfers. The government will run a balanced budget every period therefore the budget constraint of the government given by:

$$\tau_{s_t} w_{s_{b_t}} S_{p_t}(b_t) + \tau_{u_t} w_{u_{b_t}} U_{p_t} + \tau_{k_t} r_{b_t} K_p(b_t) = Tr_t$$

Equilibrium

Given taxes and transfers, an equilibrium is defined by a sequence of prices $\left\{\left\{w_{s_{b_t}}, w_{u_{b_t}}, r_{b_r}\right\}_{b=0}^{1}\right\}_{t=0}^{\infty}$, allocations $\{C_t, I_t, S_{pt}, U_{pt}, K_{pt}, S_{e_t}, U_{e_t}, K_{e_t}\}_{t=0}^{\infty}$ and technology parameters $\{b_t\}_{t=0}^{\infty}$, such that:

1.- Households maximize utility. That is they solve the problem defined by equation (2.1).

2.- Firms maximize profits. That is, for every technology parameter, equations (2.2) are satisfied.

3.- Initial conditions. That is b_0, S_0, and K_0, are given.

4.- Feasibility: $C_t + I_t \leq F\left(S_{p_t}, U_{p_t}, K_{p_t}, b_t\right)$; $0 \leq b_t \leq 1$; $0 \leq S_{p_t} + S_{e_t} \leq 1$

5.- Balanced budget of the government: $\tau_{s_t} w_{s_{b_t}} S_{pt}\left(b_t\right) + \tau_{u_t} w_{u_{b_t}} U_{pt}$

$+\tau_{k_t} r_{b_t} K_p\left(b_t\right) = Tr_t$

Since household are identical they all make the same decision, so only one type of skills and physical capital is supplied in the market, therefore only one firm actually operates in the market.

For a complete description of the functions $\left\{\left\{w_{s_{b_t}}, w_{u_{b_t}}, r_{b_r}\right\}_{b=0}^{1}\right\}_{t=0}^{\infty}$ see Appendix 2 in Moscoso Boedo (2006), where it explains how those functions behave for technology parameters that are not observed in equilibrium.

Functional forms

Following Moscoso Boedo (2006) I keep with my choices of functional forms for the utility function, production function, the educational function and the technology change cost function. The model stated above requires the choice of functional forms for the functions $u()$, $F()$, $G()$, and $H()$.

For the instantaneous utility function, I assume that it is of the form

$$u\left(C_t\right) = \frac{C_t^{(1-\varphi)}}{1-\varphi}$$

The technology adjustment cost function $G()$ is given by

$$G\left(b_t, b_{t+1}\right) = e^{\zeta\left(\frac{b_{t+1}}{b_t}-1\right)^2} - 1 \tag{2.3}$$

This function satisfies the requirements stated above, $G(b_t, b_t) = 0$ and $G(b_t, b_{t+1}) > 0$ for $b_t \neq b_{t+1}$.

Note that the function $G\left(b_t, b_{t+1}\right)$ is convex, which is in line with a whole literature of convex adjustment cost, which induce the planner or the market to take small steps in adjusting the technology instead of taking big jumps. Also note that the function $G\left(b_t, b_{t+1}\right)$ has the property that its derivatives in steady state are equal to zero. The function $G\left(b_t, b_{t+1}\right)$ is affected by only one parameter, ζ. As ζ increases the costs associated with technological change (in terms of skilled workers and physical capital), increase, affecting the dynamic transition off the model (while not in steady state).

The choice of the production function of final goods, $F()$, is not straightforward. Since one of the features I want the model to capture is the evolution of the skill premium, it should be the case that skilled and unskilled labor are imperfect substitutes. Therefore I restrict the attention to the family of nested CES functions, with inputs K_p, S_p and U_p. Let $\Omega\left(A_t, B_t; a, \varrho\right)$ be a CES function between inputs A_t and B_t with weights parameter a and elasticity parameter ϱ. The technological choice of interest is constrained to the skill biased parameter, which I will call b for "bias". Therefore I restrict the attention to the CES weights between terms containing skilled workers and unskilled workers[3]. Then the possible nested CES forms are:

- $F^1 = \Omega\left(\Omega\left(U_t, S_t; \mathbf{b}, \rho_1\right), K_t; a, \rho_2\right)$
- $F^2 = \Omega\left(\Omega\left(S_t, K_t; a, \rho_1\right), U_t; \mathbf{b}, \rho_2\right)$
- $F^3 = \Omega\left(\Omega\left(U_t, K_t; a, \rho_1\right), S_t; \mathbf{b}, \rho_2\right)$

F^1 is the production function of choice in both Heckman, Lochner and Taber (1998) and Caselli and Coleman (2005). The problem with this functional form is given by the fact that in steady state $F_b\left(b, K_p, S_p, U_p\right) = 0$ which requires that $U = \iota S$, where ι denotes some constant, independent of the level of T.F.P. The condition of $U = \iota S$ is a direct consequence of the linearity of the CES function with respect to b.

F^2 is the production function used by Krusell et. al. (2000). They argue in favor of F^2 instead of F^3 because data collected by Hamermesh (1993) suggest that the elasticity of substitution between S and U is higher than that between S and K, and function F^3 restrict them to be equal. This feature in the data comes from estimates of the partial elasticity of substitution, which depends on the levels of S, U and K, and not only on the substitution parameter. As I show later, the partial elasticity of substitution in specification F^3 between S and U is higher than that between S and K. The problem with specification F^2 is that under the parameters suggested by Krusell et. al. (2000), the endogenous technological change goes towards higher intensities in the use of unskilled labor. One alternative would be to use F^2 under a different set of

[3]Even though it is conceivable that one could make the choice of technologies be that of choosing all the parameters in the production function (ρ_1, ρ_2, a, b), I restrict the attention to only b.

parameters, but that would violate the moments estimated by Krusell et. al. (2000), in particular the elasticities of substitution between capital, skilled workers and unskilled workers. That is why I choose form F^3 as the production function in the paper[4].

To summarize the production function used in the quantitative exercise is given by

$$F\left(b_t, K_{p_t}, S_{p_t}, U_{p_t}\right) = z_t \left\{ b_t \left[aU_{p_t}^{\rho_1} + (1-a) K_{p_t}^{\rho_1} \right]^{\frac{\rho_2}{\rho_1}} + (1-b_t) S_{p_t}^{\rho_2} \right\}^{\frac{1}{\rho_2}} \tag{2.4}$$

Finally the function $H()$ is assumed to be Cobb-Douglas:

$$H\left(U_{e_t}, S_{e_t}, K_{e_t}\right) = \psi U_{e_t}^{\mu} S_{e_t}^{\xi} K_{e_t}^{1-\mu-\xi} \tag{2.5}$$

The specification of the law of motion for the stock of skilled workers does not restrict S_t to be less than 1, in the case of high enough K_e. Even though this is possible, the planner never chooses an $S_t > 1$ because the productivity of the unskilled workers approaches infinity as U_t approaches zero.

3. Data

Data to calibrate and evaluate the model come from various sources.

Data on skilled workers is taken from Barro Lee (2000). A major difference with respect to Moscoso Boedo (2006) and Caselli and Coleman (2005) is the definition of skilled worker. In those papers skilled worker was defined as those with primary

[4] F^3 is also the production function of choice in Funk and Vogel (2004).
Under the set of parameters chosen in table 1, the form F^3 does match the elasticities of substitution estimated by Hamermesh (1993), which were close to the ones estimated by Krusell et. al. (2000)

schooling or more. In the OECD context, that definition seems not to be the best to capture differences in human capital, therefore I define skilled worker as a college graduate.

Output per capita is obtained from Heston, Summers and Aten (2002).

Finally tax rates are obtained from the OECD Tax Database. Tax rates for different levels of wages can be obtained for the years from 2000 to 2005. The database reports taxes paid by the individuals earning 67%, 100% and 167% of the mean wage. In order to construct the tax schedule for a country, I generate a linear tax schedule taking the tax rates paid by the individuals at the 67% and 167% of the mean, call them τ_{67} and τ_{167}. Therefore, if in the model the unskilled worker and skilled worker are in the 50% and 150% of the mean income, they will be faced with the tax rate determined by the linear relation generated by the 67% and 167%. The tax rate on capital income is also obtained from the OECD tax Database. The actual data used in the model to construct the tax schedule for each country is shown in the appendix. An example of the linear interpolation of the tax rate is given by Figure 3.1. In the example, if the wage rate for unskilled workers w_u equals 50% of the mean wage, the linear tax schedule determines the tax rate τ_u, and with the same reasoning if w_s equals 150% of the mean wage, the linear tax schedule determines τ_s.

Therefore, once the model is calibrated, each country consists of a vector containing τ_{67}, τ_{167}, τ_k, and z (the level of total factor productivity such as the model matches the level of output per worker in each country).

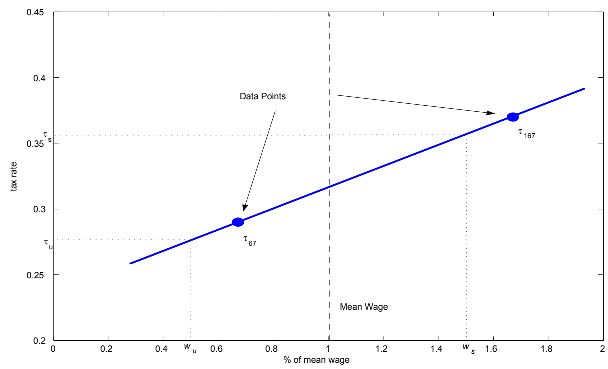

Figure 3.1: Tax rate generated by τ_{67} and τ_{167} obtained from the OECD tax database.

4. Calibration

I calibrate the model to a steady state in the US around 2000, which uses the US tax schedule for 2000. Therefore I have one less parameter in steady state, namely ζ. The match between the model and the data is shown in table 2 and the parameters that implement that match are shown in table 1. Some parameters are set according to the existing literature. For instance $\delta_k = .08$, $\beta = .96$, $\varphi = 2$ and following Manuelli and Seshadri (2005) $\delta_s = .02$.

Table 1: Parameter values in the model

Parameter	z	ρ_1	ρ_2	a	μ	ξ	ψ
Value	.3	.5	-0.2	.3	.6	.1759	.18

Table 2: Comparison between the model and the data in 2000

Moment	Model	Data US, 2000
Skill Premium	1.67	1.67[5]
Skilled workers	.28	.28[6]
Consumption Output Ratio	.85	.81[7]
Students over Labor Force	.072	.094[8]
Expenditure per pupil over GDP per worker	.21	.24[9]
Capital Share of GDP	.33	.3
Wage expenditure in education	.7036	.7036[10]

5. Cross section steady state analysis

As in Moscoso Boedo (2006), the steady state analysis consist of changing the parameter z (T.F.P) so as to match the level of output per worker shown in the appendix for the countries in the OECD database. Each country is defined not only by a different level of total factor productivity but also by an individual vector of tax rates on wages and capital income as shown in the appendix

.

[5] Using the Statistical abstract of the US for educational attainment of the population and the returns to school reported by Goldin and Katz (1999) for the year 1995, generate a wage rate per educational level as $\exp(\gamma n)$ where γ is the return to one year of school and n is the years of schooling per educational level, and then average them weighing by the number of people in each level

[6] From the US census, equal to people with college completed or more

[7] This is the ratio of Personal Consumption Expenditures to Personal income reported by the Bureau of Economic Analysis, in its table 2.1 for the year 2000

[8] Calculated as the ratio of students enrolled in college times the participation rate over the total labor force. Source: Statistical Abstract of The US for 2003 (data taken for 2000).

[9] Obtained from the Statistical Abstract of the US 1990

[10] Obtained from the Statistical Abstract of the US for 1990. Same number as in Moscoso Boedo (2006)

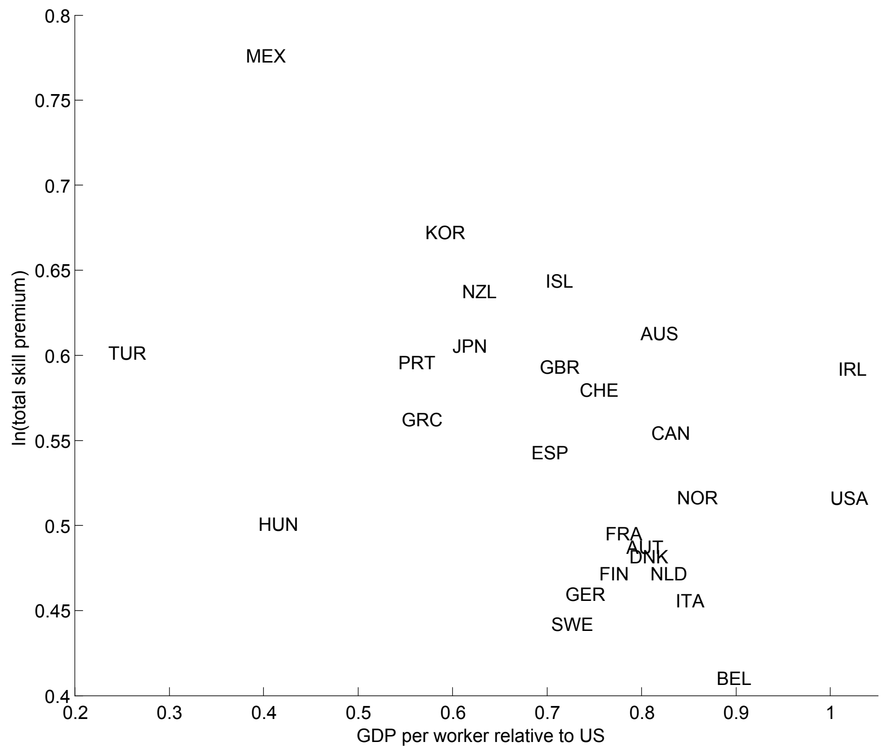

Figure 5.1: $Total\ Skill\ premium = \frac{(1-\tau_s)w_s+Tr}{(1-\tau_u)w_u+Tr}$ in the model

Figure 5.1 depicts the relation between total skill premium and output per capita, where skill premium is now defined as follows:

$$Total\ Skill\ premium = \frac{(1-\tau_s)\,w_s + Tr}{(1-\tau_u)\,w_u + Tr}$$

Other measurements related to skill premium are the ratio of pre tax and after tax wages, which are depicted in the next two figures.

The last 3 figures show that only when including taxes and transfers the model is

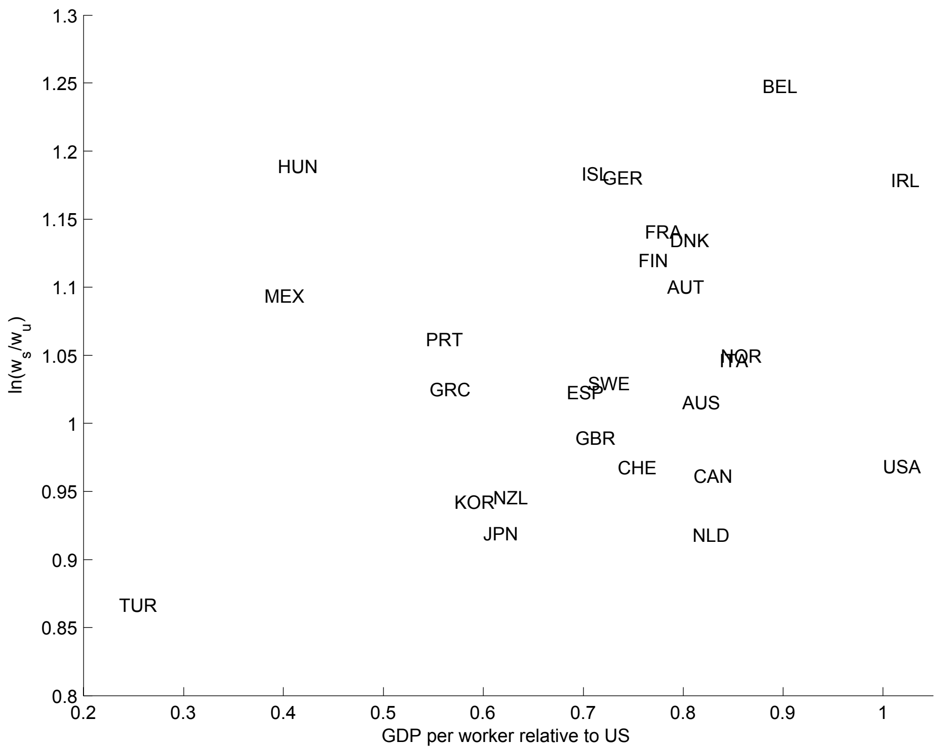

Figure 5.2: pre tax wage ratio in the model

able to replicate the relationship in terms of skill premium observed in the data, where continental Europe has a considerable lower skill premium than the US. Pre and after tax wage measurements of skill premium even go in the wrong direction when comparing continental Europe to the US.

If we compare the predictions of the model with the estimations by Acemoglu (2003), the skill premium concept that has potential of matching the data is the total skill premium. That is, once we include both taxes and transfers to determine the disposable income across the wage spectrum. The comparison between the data and model in terms of skill premium is shown in Figure 5.4.

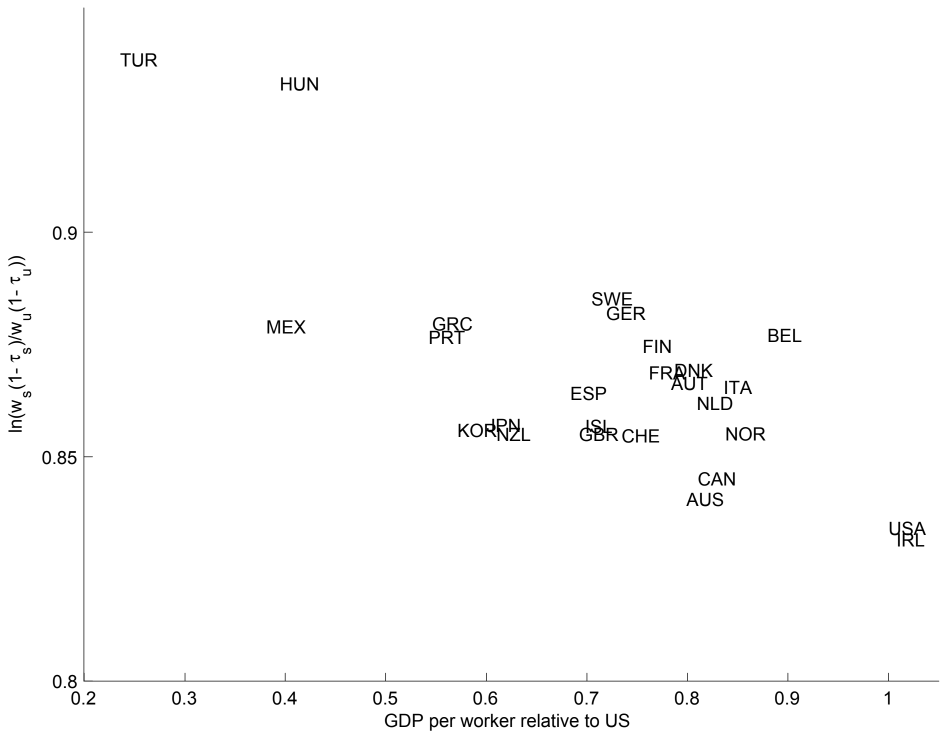

Figure 5.3: After tax ratio between wages of skilled to unskilled workers in the model

Figure 5.4 shows that the model overestimates systematically the skill premium when compared to the data, even though qualitatively it generates on average a lower skill premium for most of the European countries (relative to the US).

As Figure 5.5 shows, the effects of redistribution through the tax system generate different responses in terms of technology parameters in steady state. Keep in mind that a lower value of b indicates the choice of a production function relatively intensive in the use of the skilled labor input. Without taxes the model generated a perfectly monotonically increasing function of skill intensity $(1-b)$ to GDP per worker, but with the introduction of taxes there are some countries that in equilibrium use a relatively

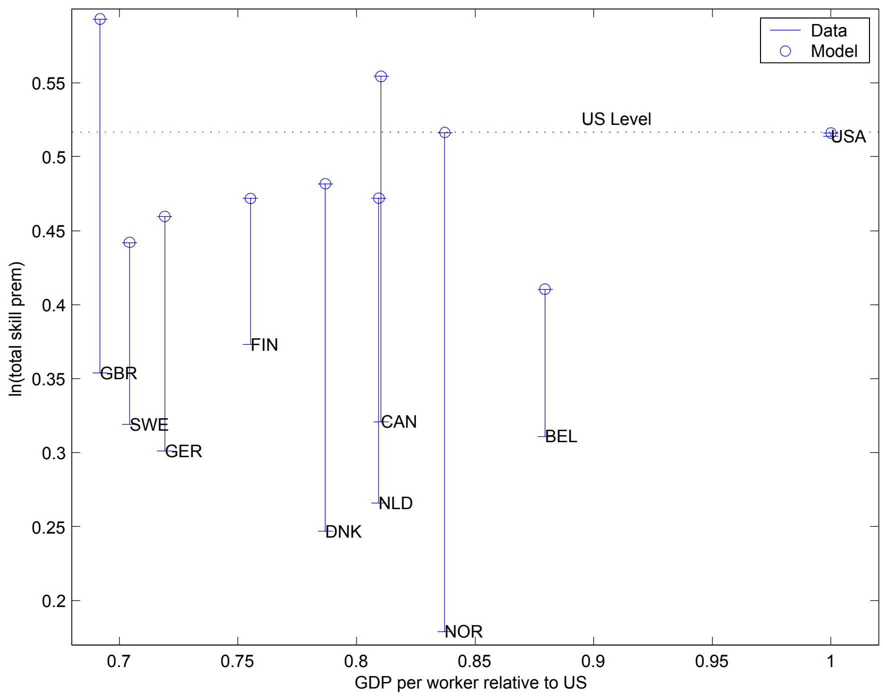

Figure 5.4: Comparison between the skill premium reported by Acemoglu (2003), table 1b, and the total skill premium predicted by the model

skill intensive technology that are not in the frontier of output per capita. Now the model predicts that those countries that constituted a cluster of lower skill premium also use technologies more intensive in the use of skilled workers. Therefore, the introduction of taxes, generated a cluster constituted mainly with the continental European countries that have a lower skill premium compared to the US, lower level of TFP (to generate their lower GDP per worker), together with skill intensive technologies (compared to the US).

In terms of the stock of skilled workers, the comparison between the data and the model is given by Figure 5.6

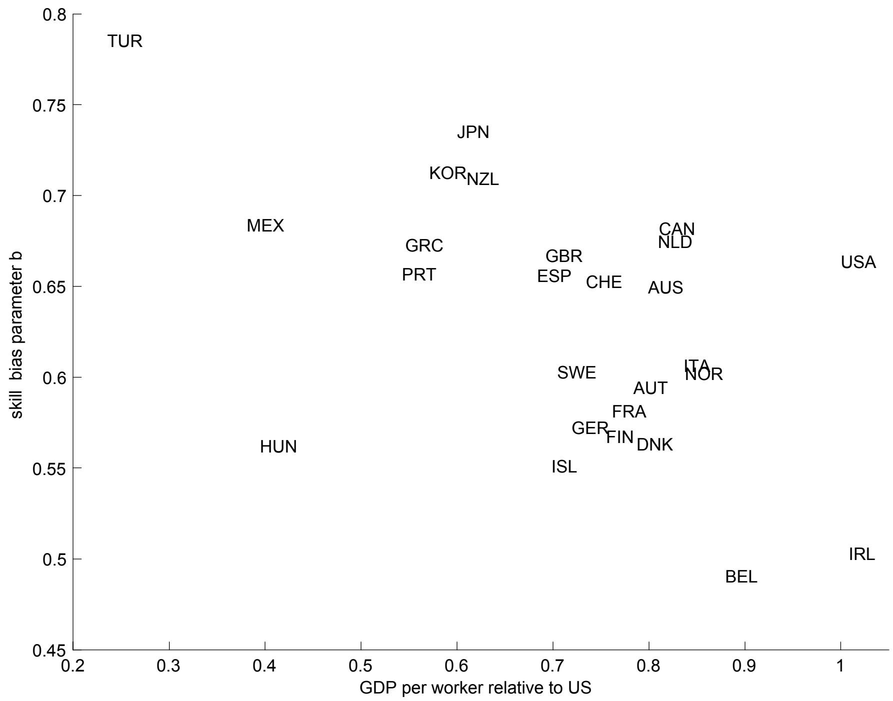

Figure 5.5: Technology parameter b predicted by the model

In every case the model predicts a higher stock of skilled workers than that observed by Barro and Lee (2000). Even though the relationship in the model and the data between skilled workers and GDP per capita is in both cases a positive one, the correlation coefficient between the data and the model is .13. This bias in terms of skilled workers also appears in Moscoso Boedo (2006), and is due to the fact that the US can be though of as an outlier and the model is calibrated to match the moments in the US economy. It is important to keep in mind that even though some European countries have "weaker" incentives than the US for the creation of skilled workers (lower skill premium), they have larger transfers, which makes the creation of skilled workers

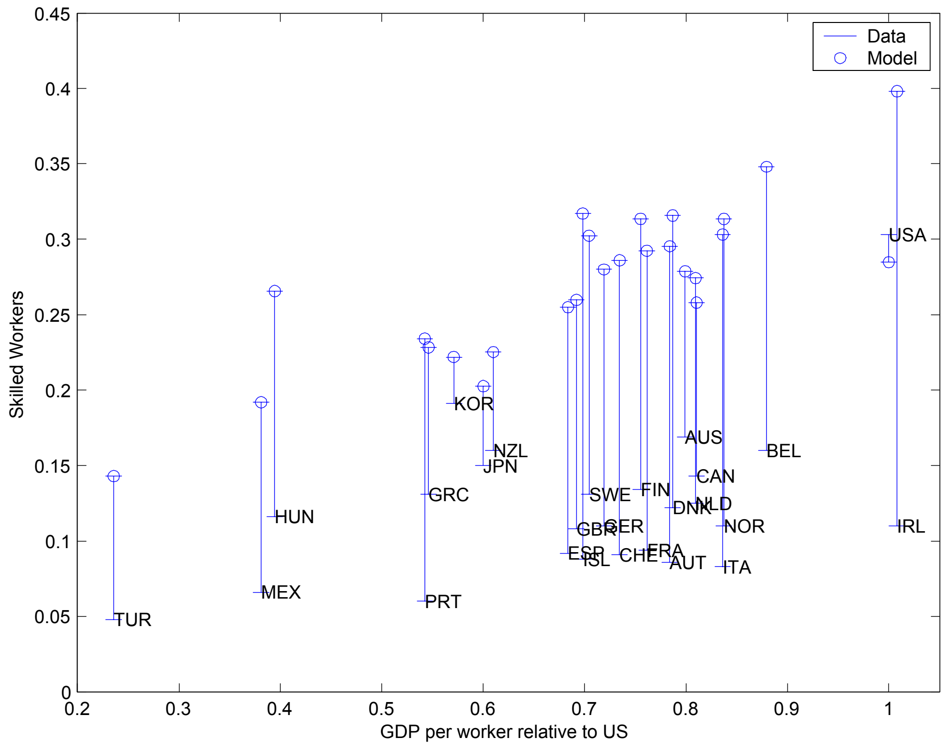

Figure 5.6:

relatively easier.

As it can be observed from this exercise, once a skill creation decision dimension is introduced, differences in tax rates are not enough to account for the differences observed in terms of the stocks of skilled workers between the US and Europe, and also predict much smaller differences in terms of skill premium. Tax rates differences were enough to induce the observed variation in hours worked across the North Atlantic as pointed out by Prescott (2004), once a model with leisure in the utility function is set up. The model presented in this paper tries to capture other labor market dimensions, such as skill creation and skill premium, and in the model of technological adoption the differences in tax rates are not enough to induce the observed patterns between the US and Europe.

6. US tax cut of 2001

In 2001 the tax rates were lowered differently across the spectrum of income. The new tax law is effective until the end of 2010. In order to capture the changes of the tax code I take the tax rates for the US in 2000 and 2005 for the 67% and 167% levels of the GDP per worker to construct the linear relation between tax rate and income level, as well as for the capital income in both years from the OECD tax database, as shown in Figure 3.1. The idea of the whole experiment is to analyze the effects of the movement of the whole tax schedule. The reported change is the following

	2000	2005
$\tau_{.67}$	.29	.273
τ_{167}	.366	.348
t_k	.394	.393

The experiment will be two fold. First I will run it as if the tax change was permanent, and then as if it was temporary and lasted what the law says (10 years). The results are reported in Figure 6.1

Comparing both experiments there seems to be no important differences in terms of the initial reaction of the economy to the new tax code. In both cases the evolution of GDP per worker and the stocks of skilled workers behave as a mirror of each other. Basically taking resources initially out of the educational sector. In terms of output, the lower taxes in general induce an increase of around 1% of GDP for the permanent case and 0.5% of GDP in the temporary one, with initial responses in terms of technology

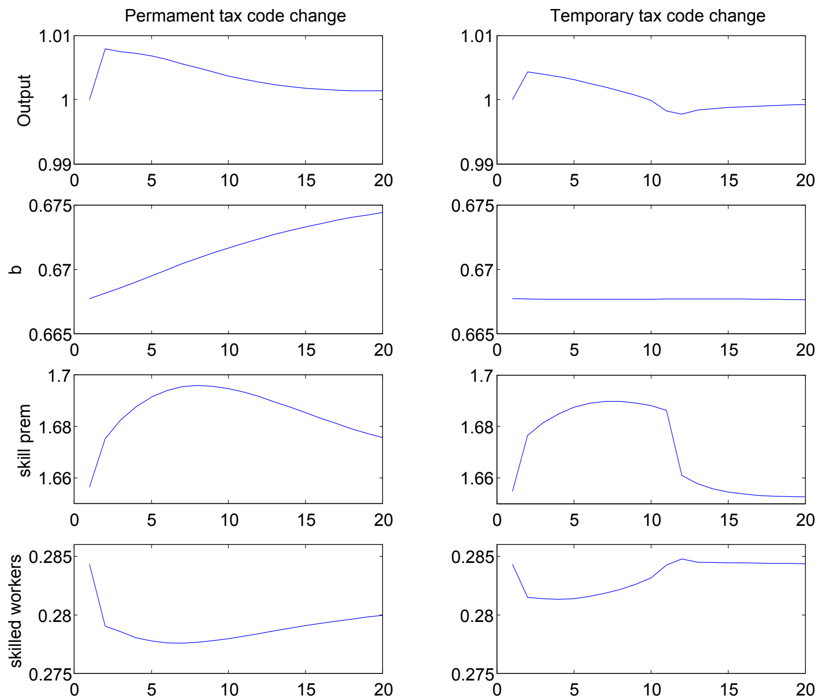

Figure 6.1: Main macro variables predicted by the model

towards unskilled intensive technologies, but very limited. That drive towards a less skill intensity, generates a loss in the stock of skilled workers. As expected, in the temporary experiment, no technological change takes place, and that is entirely driven by the cost of technical change which penalizes changes in both directions of the skill bias parameter. In the permanent case, there is a drive towards less skill intensive technologies generated by the tax changes. This also generates decreases in the stocks of skilled workers, which are demanded less intensively under the new tax environment.

7. Conclusion

The introduction of the government to the model presented by Moscoso Boedo (2006) seems to incorporate a feature seen in the data, namely that the European countries display lower levels of inequality together with lower output per worker, while maintaining the general conclusion that skill premium and level of output per worker are negatively correlated as seen in the data. It also points out the effect of the redistribution mechanism on the choice of technology, indicating that some countries may choose technologies that are more intensive in the use of the skilled labor input than that would be optimally desirable given the level of development.

Unfortunately quantitatively it is far from generating a successful explanation of the differences in terms of skill premium and stocks of skilled workers. Tax rate differences are enough to explain differences in hours worked, but in a model of technological adoption, once other labor market dimensions are analyzed, variation in tax rates, do not seem to help explain the variation in skill premium and skilled workers.

8. References

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Appendix

Country	τ_{67}	τ_{167}	τ_k	S	Y
Turkey	0.39	0.35	0.33	0.048	0.24
Mexico	0.10	0.22	0.34	0.066	0.38
Hungary	0.50	0.58	0.18	0.116	0.39
Korea, Republic of	0.15	0.21	0.30	0.191	0.57
Greece	0.34	0.41	0.35	0.131	0.55
Portugal	0.30	0.39	0.33	0.06	0.54
Spain	0.33	0.41	0.35	0.092	0.68
New Zealand	0.19	0.25	0.33	0.16	0.61
Italy	0.43	0.51	0.34	0.083	0.84
France	0.40	0.51	0.35	0.094	0.76
Germany	0.47	0.57	0.40	0.11	0.72
United Kingdom	0.25	0.33	0.30	0.108	0.69
Finland	0.43	0.53	0.29	0.134	0.76
Sweden	0.48	0.54	0.28	0.131	0.70
Austria	0.40	0.50	0.34	0.086	0.78
Belgium	0.50	0.62	0.34	0.16	0.88
Netherlands	0.41	0.44	0.35	0.125	0.81
Japan	0.23	0.27	0.41	0.15	0.60
Iceland	0.21	0.38	0.18	0.088	0.70
Australia	0.19	0.30	0.30	0.169	0.80
Ireland	0.18	0.39	0.13	0.11	1.01
Switzerland	0.27	0.34	0.24	0.091	0.73
Denmark	0.41	0.52	0.30	0.122	0.79
Canada	0.27	0.34	0.37	0.143	0.81
Norway	0.34	0.44	0.28	0.11	0.84
USA	0.29	0.37	0.39	0.303	1.00