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The Specificity of Human Capital Investment under Agent Heterogeneity and Market Frictions: Theory and Empirics

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Theory and Empirics

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Abstract

The large difference between the functioning of European and American labor markers has inspired much debate and research. Wasmer (2006) came up with an innovative explanation for this disparity based on asymmetric investment in specific and general human capital between the two economic areas. He developed a model of a labor market with matching frictions and endogenous choice of human capital investment which has never been tested empirically. The present paper expands this model to include individual heterogeneity and brings it to the data. Using international data on over 20 countries from the Luxembourg Income Study (LIS) database which has thus far been largely unexplored in this literature, it finds broad support for the model's findings. Notably, agents seem to prefer investing in specific rather than general skills when market frictions, proxied here by the unemployment rate, are high. This investment is in turn reflected in a significantly increased expected job tenure. These results are robust across countries, education levels, and controls included and should encourage further research into this so far scarcely explored territory.

Contents

1 Introduction

The differential performance of the US and European labor markets over the past few decades has drawn much attention. Might it be related to differences in the type of skill investment by the workers in the two parts of the world? And may those differences in turn be driven by the varying difficulty of finding a new job due to different labor market institutions? Wasmer (2006) suggests that this may well be the case. He develops a theoretical model of a labor market with matching frictions and endogenous choice of human capital investment. Upon finding a job, workers choose whether to invest in general or specific skills. On the one hand, specific skills make them more productive in the current job but are lost upon its termination. On the other hand, general skills make them less productive but are transferable across jobs thus avoiding reinvestment costs. Being more productive, workers who invest in specific skills can withstand a wider range of shocks with their current employer and can thus expect to keep their jobs for longer. As a consequence, a trade-off appears between maximizing value "inside" and "outside" of the job. In an environment with low frictions and thus a high job-finding rate, the outside option becomes more important and individuals prefer to invest in general skills. Conversely, in labor markets with high frictions and a low probability of finding a new job, workers want to maximize inside value and invest in specific skills. The model's predictions offer, among others, one possible explanation for differences between European-style labor markets and the American one: workers in a relatively rigid European labor market may invest disproportionately in specific skills and thus be more productive at the cost of being less adaptive to change. This paper does a long overdue empirical test of the core predictions of the model using a large international dataset with dozens of countries.

The first part of the paper presents a theoretical extension of Wasmer (2006) incorporating individual heterogeneity. The main predictions of the model are preserved; however, the coexistence of agents who have a strict preference for either specific or general education in any given labor market is introduced. The second part tests whether the main intuitions of the model hold internationally in the context of skill investment through formal education. It uses a so far understudied dataset from the Luxembourg Income Study (LIS) on over 20 different countries. The two main predictions of the model cannot be rejected: investment in specific skills is associated with a longer expected job duration and people's choice of investing in specific or general skills is influenced by frictions on the labor market as manifested through the unemployment rate.

The breadth of the dataset which contains standardized individual-level data from many countries is suitable to an initial examination of the determinants and effects of specialization. Given the initial promising high-level results, a more detailed national-level analysis is in order. The second part of the empirical analysis thus presents a case study using the German part of the LIS dataset. It is based on a deeper analysis of the educational system in the country which allows for additional robustness checks on the classification of skills acquired into specific and general and on the level of education received. The results hold. Further analysis using more detailed time-series datasets from the US and a major European economy is beyond the scope of this paper. This will be needed to confirm a causal link between the differences in setup of the US and European labor markets, the specificity of skill investment, and resulting labor market performance.

In a world searching for the best way to educate our youth and to design labor market policies which would subsequently allow them to be gainfully employed, the results of the present analysis should prove interesting beyond simply testing the predictions of a theoretical model. If the predictions of Wasmer (2006) turn out to be correct, they can help us better understand the relationship between labor market frictions and human capital investment. Much ink has been spilled trying to identify the causes of the difference between labor market performance in Europe and the US and the issue is far from settled. Any new piece to the puzzle should be welcome. Furthermore, while it is not immediately clear whether it is preferable to be in a world where workers wish to invest in specific or general skills, there is clearly a policy choice to be made. The former might work better in stable times whereas the latter might be better adapted to a changing economic environment. Once policy makers understand the mechanism driving the choice between specific and general skills, they may be able to integrate this lesson into designing improved labor market policy.

The rest of the paper is organized as follows: Section 2 provides a review of the existing literature, Section 3 presents the extended model with individual heterogeneity, Section 4 describes the data, Section 5 presents the empirical methodology, Section 6 presents the empirical results, Section 7 provides a general discussion of the broader implications of the findings presented in this article, and Section 8 concludes.

2 Background

Becker (1962) was the first to propose a theoretical framework for studying specific and general human capital. He did so in a frictionless framework and found that workers would bear the costs and benefits of general human capital (as they can transfer it across jobs) whereas firms would bear the costs and benefits of specific human capital (which is only valuable in a particular job in the case of completely specific human capital). However, the bulk of the literature on human capital accumulation has adopted a different approach. Mukoyama and Sahin (2005) note that "Following Ben-Porath (1967), the standard analysis of human capital has largely assumed that human capital is homogeneous and examined how much human capital is accumulated" (p.2).

Nevertheless, notable exceptions exist. Acemoglu and Pischke (1999) build on the early work of Becker and find that under certain conditions, firms could even pay for general human capital if they could capture some benefit from it. Krueger and Kumar (2004) look at the accumulation of specific or general human capital in a more macro context. They find that specific skills may quickly become obsolete in rapidly changing modern economies and that a stronger focus on vocational education in Europe compared to the US may be partly responsible for their diverging growth rates. While they focus on the adoption of new technologies as the main conduit through which education choice affects growth, multiple analogies can be drawn with the model presented later on in this paper. In both, the choice of investing in general or specific skills is affected both by exogenously given individual heterogeneity (called talent in this paper and ability in Krueger and Kumar, 2004) and by a macro variable (market frictions in the present study and the autonomous rate of technological change in theirs). Indeed, Krueger and Kumar (2004) note that consideration of market frictions would be "required to complete the quantitative picture" (p. 169). As such the two models can be seen as complementary.

Work by Galor and Tsiddon (1997) further shows that impediments to labor mobility could also cause Europe to trail the US. The present analysis connects these two strands of research by showing that investment in specific skills can be both a cause and a consequence of lower turnover and mobility.

Wasmer (2006) relies on an extended version of Mortensen-Pissarides (1994) and adds to the literature. He explains differences in US and European labor market outcomes with a model of endogenous human capital investment in the presence of labor market frictions. He finds that in the presence of high labor market frictions which reduce the job-finding rate workers will prefer investing in specific human capital whereas in a flexible labor market with a high job-finding rate they will prefer investing in general human capital. The intuition is that specific skills increase a worker's productivity and his expected job duration which is especially valuable when the probability of finding a new job is low. However, upon finding a new job he needs to be retrained which is costly but less so in expectation if he expects to hold fewer jobs over his lifetime. In fact, the decision between investing in specific and general human capital can be seen as maximizing value inside a given firm or outside of it. Thus, Wasmer (2006) predicts that workers in economies with high frictions (unemployment benefits, firing cost, etc.) as exemplified by many continental European economies will tend to invest in specific skills. They will thus be more productive and increase their expected job duration at the cost of being less mobile and adaptive to change. As agents in Wasmer (2006) are homogeneous, they all either prefer investing in general skills, in specific skills, or they are indifferent and employ a mixed strategy.

Rajan (2010) comes to a similar conclusion when comparing the US and European financial systems. On the one hand, in the US arms length system, there is pressure on achieving immediate results and thus workers are shed ruthlessly in downturns. The US labor market laws permit this and the flexible labor market facilitates quick re-entry once conditions improve, thus leading to a high turnover economy. On the other hand, the European relationship system allows managers more leeway and lets them keep valuable workers through downturns. "Conversely, workers are more loyal and have the incentive to develop skills that make them especially valuable to the firm, even if those skills are not easily marketable elsewhere." (Rajan 2010, p. 91). He further notes that European governments contribute to the tendency by trying to preserve existing jobs.

Another strand of the literature studying the accumulation of human capital deals with the (usually unobserved) individual ability which influences education choices. The initial framework developed by Roy (1951) relies on the assumption of comparative advantage and points out the importance of the variance of the skill distribution. Willis and Rosen (1978) further develop this model by also taking into account the personal characteristics of the individual.

On the empirical side, a recent OECD working paper (Brunello and Rocco, 2015) looks at the effect of vocational training on the probability of employment, skill acquisition, and wages. They use the 2011 OECD Survey of Adult Skills (PIAAC). The survey covers 24 OECD countries. In the absence of an economic model, the authors try to control for endogenous selection by assuming that it is based solely on observables (parental education, country of birth, and the number of books in the household at age 16). The authors estimate a multinomial logit model of selection into vocational/academic education at high school and university levels using these variables as controls. Unlike in the present study, no macroeconomic variables are used. Controlling for selection on observables, the authors find a generally slightly inferior performance of vocational education, especially at the university level. However, the employability outcome is somewhat positive (time spent at work, current employment status) but this result varies across countries, gender, and age groups.

Other empirical research has focused on the effect of vocational education on finding a job at a young age or at wage outcomes. Ryan (2001) and Wolter and Ryan (2011) find that vocational training facilitates entry into the job market. Hotchkiss (1993) finds no effect of vocational schooling on wages using US data whereas Bishop and Mane (2004) and Meer (2007) find a positive effect. Other research finds the opposite general effect (Robinson, 1997 and Dearden et al., 2002) but leaves open the possibility that vocational education helps low achievers.

Lamo et al. (2010) have examined the effect of investing in specific skills on worker mobility and ability to adjust to changes in the economy. Similar to this paper, they proxied for the worker's choice of specific or general human capital by his choice of receiving either a vocational or a general education. Using data from Poland and Estonia, they find that specific skills are associated with longer unemployment and even cessation of activity for older workers. Using quantitative exercises based on a theoretical model developed for this purpose they note that specialization has likely made for a more difficult transition for Poland during the enlargement of the European Union.

Lowenstein and Spletzer (1999) examined the effect of on-the-job training on worker mobility (whether he held the same job from one year to another or not). They used data from the Employer Opportunity Pilot Project survey and from the 1993 National Longitudinal Study of Youth. These datasets contain questions regarding training/learning on the job including the workers' and/or employers' subjective opinions on the degree of transferability of these skills. The authors find that most training received is useful outside of the current job.

Finally, efforts have been made to control for endogenous selection through a difference-in-differences framework (Oosterbeek and Webbink, 2007) or natural experiments (Malamud and Pop-Echeles, 2010). These studies provided limited evidence as to the effect of vocational education on labor market outcomes.

To the best of my knowledge, little work has been done thus far on empirically determining the relationship between specific and general skill investment and job tenure. The same holds for rigorously examining the role of market frictions in human capital investment decisions. The present analysis attempts to fill this gap.

3 Theoretical Model

The following model is an extension of Wasmer (2006) who presented a theoretical model of a labor market with matching frictions and endogenous choice of human capital investment. It is modified to include individual heterogeneity, expressed in a dimension called talent. The introduction of heterogeneity is necessary for the simultaneous co-existence of individuals some of whom, in any given labor market, strictly prefer investing in general skills while others want to specialize (an empirical observation). Talent augments workers' productivity if they invest in general skills but not if they invest in specific skills (in the latter case, their productivity on the job that they possess specific skills for is already maximal regardless of talent). As such this variable is closely related to versatility or the ability to apply one's skill set to diverse new contexts. The main predictions of Wasmer (2006) are retained: (1) workers who invest in specific skills have at least weakly higher productivity than those who invest in general skills (in our model the two productivities converge for an individual with maximum talent); and (2) market frictions and the associated low job finding rate encourage investment in specific skills. As individuals are homogeneous in the original model, for a given job finding rate they all want to either invest in specific skills or in general skills or they are indifferent and randomize. With the addition of heterogeneity, the augmented model predicts that for any given economic environment, there will always be some individuals with at least a weak preference for each type of skill. This should help explain the empirical fact that at any given point in time some individuals prefer investing in specific skills while others prefer investing in general skills and that this preference is generally not a result of a coin flip (i.e. of indifference).

3.a Set-up

3.a.i Workers

Like in Wasmer (2006), workers die at a Poisson rate δ and are replaced by new-born workers. At the entry into the firm, each new-born worker can decide between three options: investing in specific skills (h^s), investing in general skills (h^g) or choosing no investment (h^0). Following Wasmer (2006) we assume that h^0 is so low that its choosing would dissolve the match. Each investment requires a cost which is respectively equal to C^s, C^g or 0. This distinction between human capital investment comes from Becker (1964). As he mentioned in his article, in reality human capital investment is not strictly delimited between specific and general skills. However, such a distinction can be useful in theory. It implies that investment in general skills spares the worker an additional cost of investment in human capital when he finds a new job. As Wasmer (2006) mentions, "if the worker subsequently leaves the firm, specific skills are lost but general skills are retained".

Contrary to Wasmer (2006) where workers do not differ between each other, each worker i has a parameter m_i such that $h^s \geq m_i h^g$. The main intuition behind this is that talent can improve the ability of a worker to meet the specific requirements of a firm with general training, despite his lack of specific human capital. This parameter m_i can follow any density function l as long as its support is defined on $[0, \frac{h^s}{h^g}]$. We have chosen 0 as the lower limit to reflect the fact that some individuals may not be able to apply general skills to specific firms at all. Conversely, we have chosen the upper limit as it seems implausible that even a very talented individual could achieve a higher productivity through general skills than they would by acquiring skills specific to the firm he is currently in.

Considering that the control variable $e = 0, s, g$ is the type of investment and that the state variable $k(e) = s, g$ is the human capital, we can rewrite the program of an unemployed worker with no capital as usual.

$$(r + \delta)U_i^0 = b + p \max_{e=s,g}(W_{0,i}^{k(e)} - C^e) - pU_i^0 \tag{1}$$

$$s.t. W_{0,i}^{k(e)} - C^e \geq U_i^0 \tag{2}$$

The difference with the framework of Wasmer(2006) is that $W_{0,i}^g$ is specific to each individual while W_0^s is common to all workers. Indeed, as the Bellman equations show, the asset value of general skills depends on the wage which itself depends on the productivity of the worker (See the Appendix for a mathematical proof). The asset values of employment and unemployment do not need to be indexed by i for individuals with talent low enough such that they choose to invest in specific skills as the productivity of their human capital is the same. The talent cutoff for choosing general rather than specific skills will depend on the characteristics of the labor market (market frictions) which then feed into the equilibrium job-finding rate.

Equation (1) shows that the present discounted asset value of the new born unemployed U_i^0 is equal to the level of unemployment benefits plus the difference in asset value of being employed and unemployed multiplied by the job finding rate. The second equation embodies the assumption that workers are not discouraged from learning and investing in human capital. When the worker leaves the firm, $k(e)$ becomes $k'(e)$. For workers who previously invested in specific skills $k'(s) = 0$ as these skills are useless in any other firm. Workers who invested in general skills can apply them in any context and thus $k'(g) = g$. Like in Wasmer (2006), the model focuses on the stationary aggregate state where workers repeat their initial choice upon each re-entry to a new job. More precisely, if a new born worker strictly prefers general skills in his first job, he will never invest later on in general skills as $W^g_{0,i} - C^g > W^s_0 - C^s$ implies also that $W^g_{0,i} > W^s_0 - C^s$. In the same way, if a new born worker strictly prefers specific skills, he will never invest later on in general skills ($W^s_0 - C^s > W^g_{0,i} - C^g$). If he is indifferent, he randomizes according to a mixed strategy. Workers who have previously chosen specific skills will randomize again in their second job (please note however, that in this case the mass of workers who actually "randomize" will be zero as the probability that a worker has any specific draw from the talent distribution is zero[1]).

3.a.ii Firms

The marginal productivity of a worker depends on a firm component and on the human capital investment of the worker. For general investment, the ability of a worker to increase his productivity by adapting his general skills to the firm specificity depends on his talent.

In other words, the marginal productivity of a worker i is y_i such that:

$$y_i = \epsilon + (1 - I_k)m_i h^k + I_k h^k \tag{3}$$

Where I_k is equal to 0 when $k = g$ and 1 when $k = s$. As in Wasmer (2006), the worker first chooses his investment in human capital at his entry into the firm, rationally anticipating the outcome in terms of wages and job duration. Like Wasmer (2006) we also assume that the initial productivity draw for each match is its maximum value. Then, another value of ϵ is drawn at a random time from a density function f and follows a Poisson process with parameter λ. If there is still a positive surplus, the worker and the firm can bargain for a new wage. Otherwise, the match is dissolved but a firing tax T has to be paid by the firm.

3.b Surplus sharing

As in Wasmer (2006), the total surplus of a match can be divided between the surplus of the worker and the surplus of the firm. More precisely, the surplus of the worker is equal to the present discounted value of employment ($W^g_{0,i}$ or W^s_0) minus the asset value of being unemployed upon separation (U^g_i or U^0). The surplus of the firm is equal to the firm's value ($J^g_{0,i}$ or J^s_0) minus the outside option (V) of the firm which depends on the distribution l of the talent among the population. We thus have $\forall i$ in the initial period for a given match:

$$S^g_{0,i} = W^g_{0,i} - U^g_i + J^g_{0,i} - V \tag{4}$$

[1]Talent follows a continuous distribution.

$$S_0^s = W_0^s - U^0 + J_0^s - V \quad (5)$$

After another productivity ϵ is drawn, the surplus is defined as:

$$S_i^g(\epsilon) = W_i^g(\epsilon) - U_i^g + J_i^g(\epsilon) - (V - T) \quad (6)$$

$$S^s(\epsilon) = W^s(\epsilon) - U^0 + J^s(\epsilon) - (V - T) \quad (7)$$

Where $W_i^g(\epsilon)$ and $W^s(\epsilon)$ are the the asset value of holding a job for an employee who respectively made the choice of general skills and the choice of specific skills.

Each time, the worker and the firm bargain for their share of the total surplus. Note that β represents the bargaining power of the worker with $0 \leq \beta \leq 1$. One can therefore derive all wage equations (see Appendix)

3.c Job destruction

After a shock to the firm's productivity component (ϵ), the total surplus can be negative or positive. If it is negative, it will be optimal for the worker and the firm to separate. As in Mortensen and Pissarides (1994), one can define the reservation productivity as R^k such that $S(R^k) = 0$. However, contrary to Wasmer (2006), the reservation productivity for general human capital is specific to each individual as it depends on their talent. The reasoning for general skills is as follows:

One can find a non-explicit formula for R_i^g from equation (8) obtained in the appendix:

$$(r + \lambda + \delta)S_i^g(\epsilon) = \epsilon + m_i h^g - (r + \delta)(U_i^g + V - T) + \lambda \int Max[0, S_i(z)]dF(z) \quad (8)$$

By integrating by parts $\int_{R_i^g}^{\epsilon_0} S(z)dF(z)$, one finds:

$$\int_{R_i^g}^{\epsilon_0} S(z)dF(z) = S(\epsilon_0) - \frac{1}{r + \delta + \lambda} \int_{R_i^g}^{\epsilon_0} F(z)dz \quad (9)$$

And as $S(\epsilon_0) = \frac{1}{r+\delta+\lambda} \int_{R_i^g}^{\epsilon_0} dz$, one obtains: $\int_{R_i^g}^{\epsilon_0} S(z)dF(z) = \frac{1}{r+\delta+\lambda} \int_{R_i^g}^{\epsilon_0} [1 - F(z)]dz$

Using this result and the definition of R_i^g, equation (8) can be rewritten as:

$$R_i^g + m_i h^g + \frac{\lambda}{\lambda + r + \delta} \int_{R_i^g}^{\epsilon_0} (1 - F(z))dz = (r + \delta)(U_i^g + V - T) \quad (10)$$

A similar equation can be found for specific human capital. The only difference will be that this equation will not be specific to each individual.

Looking at equation (10), some comments are of order. First, we can notice that the left-hand side is increasing in m_i. This means that the more talented the worker is, the lower his reservation productivity for general skills is. In other words, a more talented individual will obtain a longer expected job duration conditional on having invested in general skills as he can support a wider range of shocks to ϵ while still maintaining a productive match. This leads us to a second point. Comparing investment in specific skills with investment in general skills, we have to remember that specific human capital is more productive than general human capital unless the worker is highly talented. Formally, our underlined assumption is: $\forall i, h^s \geq m_i h^g$. Therefore, the reservation productivity of general skills will be higher or equal to the reservation productivity of specific skills. As job duration is equal to $\frac{1}{\lambda F(R_i^k)}$, workers who had invested in general skills will have a lower expected job duration than those who had invested in specific skills but the gap will tend to 0 when we consider the most talented workers.

3.d Partial Equilibrium

As in Wasmer (2006), the partial equilibrium is determined by considering as given V and p. It is characterized by the decision e made by new born and older workers (those choices are then repeated in each further match). As before, the only difference concerns the equations involving general skills which have to take into account the talent of the individual.

Thanks to the wage equations derived in the Appendix, we obtain:

$$i = ArgMax[W_{0,i}^{k(e)} - C^e] \tag{11}$$

$$with\ W_{0,i}^g = \beta \left(\frac{\epsilon_0 - R_i^g}{r + \lambda + \delta} - T \right) + U_i^g \tag{12}$$

$$W_0^s = \beta \left(\frac{\epsilon_0 - R^s}{r + \lambda + \delta} - T \right) + U^0 \tag{13}$$

$$\text{If } e = s,\ (r + \delta)U^0 = b + p\beta \left(\tfrac{\epsilon_0 - R^s}{r+\lambda+\delta} - T \right) - pC^s.$$

$$\text{If } e = g,\ (r + \delta)U_i^g = b + p\beta \left(\tfrac{\epsilon_0 - R_i^g}{r+\lambda+\delta} - T \right)$$

3.d.i The Trade-Off

The basic trade-off is also similar to Wasmer (2006) but some slight differences have to be pointed out. Assuming that $C^s = C^g = C > 0$, the trade-off is defined in the following terms:

- **a)Outside option of workers**:

  Any unemployed worker is better off if he has previously invested in general skills than in specific skills: $\forall i, U_i^g \geq U^0$ with equality when $p = 0$ ($U_i^g = U^0 = \frac{b}{r+\delta}$)

- **b)Duration of jobs:** As was mentioned before, jobs last longer, in expectation, when workers have invested in specific human capital instead of general human capital but a more talented worker will have a longer job duration when he has invested in general skills compared to a non talented one. Therefore, unlike Wasmer (2006), we have $R_i^g(m_i) \geq R^s$ with equality when $m_i = \frac{h^s}{h^g}$.

- **c)Trade-off**: The choice of specific skills occurs when the effect of the second mechanism dominates the effect of the first one. We can easily deduce that the more talented the worker is, the more likely the first effect will dominate the second one as the difference in expected job duration if he invests in specific rather than general skills is reduced. For the most talented worker, one can see that he will only choose to invest in general skills as for him, the job duration with specific skills is equal to the job duration with general skills.

Proof:

a) The unemployed worker, who previously chose specific skills, faces an additional cost C^s compared to an unemployed worker with general skills as he cannot retain his level of human capital. Therefore, $\forall i, U_i^g \geq U^0$. Note that the more talented the worker is, the lower is R_i^g and the higher is his utility derived from the choice g. Moreover, when $p = 0$ $\forall i, U_i^g = U^0$: the unemployed only obtains the present discounted value of unemployment benefits.

b) We introduce $\forall i$, $\Delta R_i = R_i^g - R^s$, $\Delta h_i = m_i h_i^g - h^s \leq 0$ and $\Delta U_i = U_i^g - U^0 \geq 0$. By subtracting, the equations implicitly defining R_i^g (10) and R^s, we find:

$$\Delta R_i + \frac{\lambda}{r+\delta+\lambda}\int_{R_i^g}^{R^s}(1-F(z))dz = (r+\delta)\Delta U_i - \Delta h_i \tag{14}$$

Using proof by contradiction, we assume that $\forall i$, $\Delta R_i < 0$. The right-hand side is positive or null as $\Delta h_i \leq 0$ and $\Delta U_i \geq 0$. Therefore, it is impossible that $\forall i$, $\Delta R_i < 0$ as an integral is always positive or equal to 0. We therefore obtain $\forall i$, $\Delta R_i \geq 0$ with equality when $m_i = \frac{h^s}{h^g}$

c) Trade-off: New-born worker i will prefer specific skills to general skills if $W_0^s = \beta\frac{\epsilon_0 - R^s}{r+\lambda+\delta} + U^0 > W_{0,i}^g = \beta\frac{\epsilon_0 - R_i^g}{r+\lambda+\delta} + U_i^g$ so when $\Delta U_i = U_i^g - U^0 < \beta\frac{R_i^g - R^s}{r+\lambda+\delta}$.

Therefore, contrary to Wasmer (2006), the trade-off is individualized. A higher m_i (a more talented worker) will have a lower ΔR_i and as a result, this condition will be more difficult to satisfy. In other words, investment in general skills will be more likely preferred by talented agents.

3.d.ii Skills and frictions

- **Effect of the job finding rate on the choice of skills:**

  As in Wasmer (2006) for low values of p, workers invest in specific skills. For large values of p, workers invest in general skills. The main difference is that each worker now has his own specific threshold.

  Define $p_i^M(V)$ the values of p such that worker i is indifferent between general and specific skills. For any individual and any V , there is at least one such p^M. Under the sufficient condition that ΔR_i is locally inelastic towards p or that job destruction rates are as elastic in g-jobs as in s-jobs for p close to $p_i^M(V)$, there is a unique cutoff point $p_i^M(V)$ - see Appendix. For all $p > p_i^M(V)$, worker i will prefer general skills.

  It is also shown in the Appendix that p_i^M declines with V for each worker and has a finite limit for large V.

- **Effect of the threat point of firms in bargaining V on the choice of skills**:

  For a given level p, there are cut-off points for V above which worker i does not invest in human capital and below which he invests in either general or specific skills. These cut-off points decrease with p.

The proof of this theorem is done in the appendix. However, we explain below the consequences of including individual heterogeneity (talent).

First of all, concerning the trade-off between specific and general skills, we have to pay once more attention to our first results.

When we described the job destruction process, we noted that an increase in talent reduces the reservation productivity R_i^g which is equal to R^s for the most talented workers. The intuition is the following: when the firm employs a worker with general skills who is highly talented, the surplus will be higher than if the match involved a worker with general skills who has less talent. Indeed, the productivity of the firm will increase and will tend to be as high as the productivity of a firm employing a worker with specific skills in the limit. Moreover, the asset value of being employed with general skills will also be higher. As the total surplus is higher, a more negative productivity shock is needed to see the match dissolved. This lowers reservation productivity and increases expected job duration.

Thus, when a worker is highly talented, he tends to still prefer general skills to specific skills at a lower job finding rate p than his less talented brethren. Indeed, as we saw before, a more talented worker will tend to prefer general skills as he does not have to repay the cost C and tends to have the same job duration as with specific skills. Therefore, a talented worker can prefer general skills to specific skills even in the presence of frictions (smaller p) as his job duration will be higher than for a non-talented individual. The extreme case concerns the most talented worker for whom the duration of a job is the same when he invests in specific skills or in general skills. For this individual, for any level of frictions (as large as it may be), he will at least weakly prefer general skills to specific skills as he will not have to repay C and will expect the same job duration (for $p = 0$ he would be indifferent between the two as his chance of finding another job would be zero and thus he would never have to retrain even if he chose specific skills). Mathematically, this can be demonstrated by the following equation, derived from equation (44) in the Appendix:

$$p_i^M = (r+\delta)\frac{\beta \Delta \tilde{R}_i C}{(r+\delta+\lambda)C - \beta \Delta \tilde{R}_i} \tag{15}$$

Thanks to equation (10), we can see that the more talented the worker is, the lower the individual cut-off between specific and general skill (p_i^M) is as the gap between the reservation productivities is lower. For the most talented worker, p_i^M is equal to 0 as the reservation productivities will equalize.

The intuition is quite similar concerning the trade-off between investing in skills or not investing at all. In the presence of a high threat point V, the surplus decreases which reduces the incentives to invest in skills. However, for a highly talented worker, the asset value of being employed and having invested in general skills will also be higher than for a non-talented worker. Therefore, compared to a low-talent worker, a higher threat point V is needed for a high-talent worker to prefer not to invest in skills at all rather than investing in general skills. The proof is in the Appendix.

3.e General Equilibrium

As we take into account worker's heterogeneity, our results differ from Wasmer (2006). In his previous article, there are three regimes at steady-state: two pure regimes where all the workers choose to invest in specific skills or in general skills and one mixed regime where all the workers are indifferent. Here, we will have one steady-state with the proportion of workers investing in specific skills or in general skills depending on the equilibrium value p^*.

3.e.i Value of a vacant position and matching

Under equation (2), there is no worker who will refuse to invest in skills. The population can be therefore divided between workers who invest in specific skills and workers who invest in general skills. As it was proven before, for a given job finding rate, talented workers will tend to prefer general skills to specific skills more than non-talented ones. We can then write the value of a vacant position V taking as given the cost γ of posting a vacancy.

$$(r+q)V = -\gamma + q(1-\beta)\kappa^s \left(\frac{\epsilon^0 - R^s}{r+\lambda+\delta} - T\right) + q(1-\beta)\int_{m_l}^{\frac{h^s}{h^g}} \left(\frac{\epsilon^0 - R^g(\mu)}{r+\lambda+\delta} - T\right) \frac{u^g(\mu) + l(\mu)\eta u^0}{u} d\mu \tag{16}$$

Where κ^s represents the fraction of unemployed workers who will choose to invest in specific skills, ηu^0 the fraction of unemployed workers with no human capital who are new born (they never worked before), and $\frac{u^g(\mu)}{u}$ is the fraction of unemployed workers, for each talent level, who invested in general skills in a previous job. All are derived in the appendix. Put together, $\frac{u^g(\mu)+l(\mu)\eta u^0}{u}$ represents the fraction of unemployed individuals who will choose general skills and who have a particular level of talent. Furthermore m_l represents the talent cutoff above which workers choose to invest in general skills. It is formally derived in equation (20) of the next section.

We can then introduce the usual matching function $x(u, \nu)$ posing the labor market tightness θ equal to ν/u where ν is the number of recruiting firms and u the number of unemployed workers.

$$q = q(\theta) = \frac{x(u,\nu)}{\nu} \tag{17}$$

$$p = p(\theta) = \theta q(\theta) \tag{18}$$

Similarly to Wasmer (2006), it can be shown that the value of a vacant position is a decreasing function of the job finding rate. We can thus obtain an aggregate function $V(p)$ which will be the same for all workers. [2]

[2] The only difference is that each worker has a different value for p_i^M depending on their talent.

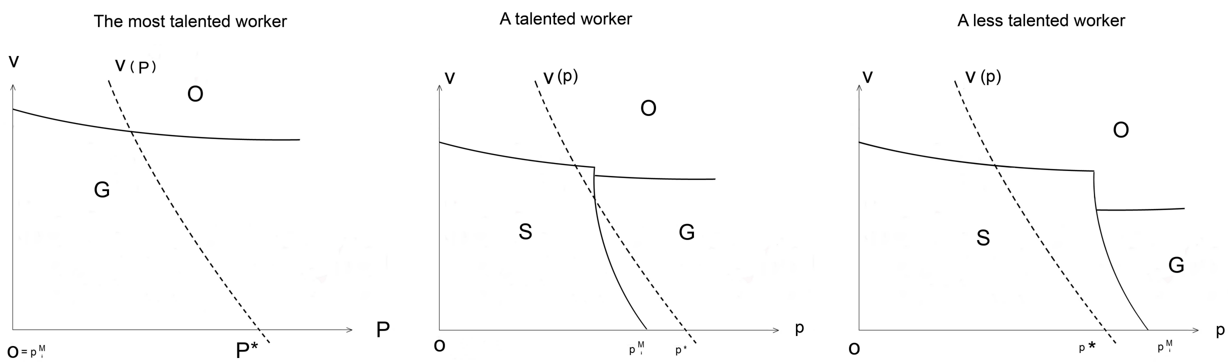
3.e.ii Entry of firms and equilibrium

With the free-entry condition at steady-state, $V(p^*) = 0$. This implies that there are no more job creation opportunities.

We can thus consider two cases:

- **For the most talented worker[3] who has** $m_i = \frac{h^s}{h^g}$:
  - $p_i^M = 0$
  - $\forall p^*$, i prefers general skills to specific skills
  - At equilibrium, worker i will always invest in general skills as long as equation (2) is satisfied.
- **For a less talented worker defined by** $0 \leq m_i < \frac{h^s}{h^g}$**:**
  - $p_i^M > 0$
  - If $p_i^M < p^*$, worker i will prefer general skills to specific skills in equilibrium.

    If $p_i^M > p^*$, worker i will prefer specific skills to general skills in equilibrium.
  - This worker is less talented than the first one. Therefore, compared to the previous one, a lower threat point value of V is required for the cut-off between no investment and general human capital investment.



Our parameters of interest are κ^g and κ^s which are respectively the proportion of workers investing in general skills and the proportion of workers investing in specific skills in this economy.

One way to define them is to compute $m_l(p^*)$ which refers to the lowest talent required for a worker to prefer to invest in general skills taking as given p^*.

Transforming equation (15), the worker who is the least talented among those choosing general skills (thus he is indifferent and his p_i^M is equal to the economy job finding rate p^*) will satisfy this equation at equilibrium:

$$(r + \delta)\beta C \Delta R(m_l) = p^*[(r + \delta + \lambda)C - \beta \Delta R(m_l)] \tag{19}$$

[3]As mentioned before, please note however that the probability that talent is equal to the upper bound is null. This case is therefore useful only to show the intuition.

Therefore, we find:

$$m_l = \Delta R^{-1}\left(\frac{(r+\delta+\lambda)C}{\beta}\frac{p^*}{(r+\delta)C+p^*}\right) \tag{20}$$

As $\Delta R(m_i)$ is defined, continuous and strictly decreasing, ΔR^{-1} will also be strictly decreasing. Therefore, the higher is p^*, the lower will be m_l.

In other words, the higher is the job finding rate in equilibrium, the more workers have p_i^M below p^* and thus, the more workers will prefer general skills to specific skills.

Four equations then characterize the steady-state:

- The job creation margin:

$$\frac{\gamma}{q(\theta^*)} = (1-\beta)\kappa^s\left(\frac{\epsilon_0 - R^s}{r+\lambda+\delta} - T\right) + (1-\beta)\int_{m_l}^{\frac{h^s}{h^g}}\left(\frac{\epsilon^0 - R^g(\mu)}{r+\lambda+\delta} - T\right)\frac{u^g(\mu)+l(\mu)\eta u^0}{u}d\mu \tag{21}$$

- The job destruction equations:

$$R_i^g + m_i h^g + \frac{\lambda}{r+\lambda+\delta}\int_{R_i^g}^{\epsilon^0}(1-F(\epsilon'))d\epsilon' = b + q(\theta^*)\theta^*\beta\left(\frac{\epsilon^0 - R_i^g}{r+\lambda+\delta} - T\right) - (r+\delta)T \tag{22}$$

$$R^s + h^s + \frac{\lambda}{r+\lambda+\delta}\int_{R^s}^{\epsilon^0}(1-F(\epsilon'))d\epsilon' = b + q(\theta^*)\theta^*\beta\left(\frac{\epsilon^0 - R^s}{r+\lambda+\delta} - T\right) - q(\theta^*)\theta^* C^s - (r+\delta)T \tag{23}$$

- The proportion of workers preferring specific skills and general skills respectively:

$$\alpha^s = \int_0^{m_l} l(\mu)d\mu \tag{24}$$

$$\alpha^g = 1 - \alpha^s = \int_{m_l}^{\frac{h^s}{h^g}} l(\mu)d\mu = L\left(\frac{h^s}{h^g}\right) - L(m_l) \tag{25}$$

With $m_l(q(\theta^*)\theta^*)$ defined by equation (21). Note that l is the pdf of the talent distribution and L is the cdf.

3.f Implications for Empirical Work

The introduction of individual heterogeneity changes the trade-off of a worker between specific human capital investment and general human capital investment.

Being more talented increases the total surplus of the match between the firm and the worker when he invests in general skills. In that sense, the more talented the worker is, the longer his expected job duration is if he invests in general skills. Thus talent reduces the gap between the reservation productivity with specific skills and the reservation productivity with general skills. For the most talented workers, the reservation productivity (and thus job duration) is equal for both types of investment. As specific skills require an additional cost when a new match is formed, this type of worker will always prefer general skills in equilibrium. These findings also imply that controlling for talent (or unobserved individual heterogeneity) is important in empirical testing of the model. They show the direction of the bias if this were not done properly: Omitting talent would lead to an underestimation of the positive effect of specific skills on job tenure.

In equilibrium, we always have at least one worker indifferent between general and specific skills. The pure regimes found in Wasmer (2006) thus disappear. In our essay, the higher is the equilibrium job finding rate, the higher is the proportion of workers choosing general skills. This framework implies that the choice between human capital types depends both on economic conditions and on individual heterogeneity. It is an empirical question whether this is so in reality and whether the extended model adds value compared to the original one as a consequence.

4 Data Set

The bulk of the data come from the Luxembourg Income Study (LIS) database. The database contains harmonized microdata collected from about 50 countries in Europe, North America, Latin America, Africa, Asia, and Australasia spanning five decades. While the main focus of this dataset is to provide detailed income and financial information on the households and individuals sampled, it also contains an array of additional information useful for the present analysis. This includes information on the type of highest education achieved, job tenure in the current job, and basic demographic characteristics including parents' education in the more recent datasets.

This paper analyses data from all countries included in the LIS database which have sufficiently detailed education information to allow for classification into specific and general training. The German dataset is explored in more detail as it concerns a large economy with a much discussed education system and contains multiple waves of data with information on additional control variables.

The analyzed dataset covers almost 30 countries.[4] It contains 1,506,148 individual-level observations on people over 15 years old who have finished their schooling and who have sufficient information on the type of education chosen to allow classification into general and specific. The sample for the skill choice analysis has 339,889 observations with matched unemployment information. The sample for the job tenure analysis focuses on regular, full-time, private sector jobs held by non-disabled agents as this context seems the most appropriate for testing the theoretical model. It contains 71,390 observations with information on job tenure from 12 countries.[5] See **Figures 1 through 3** in the "Tables and Figures" section at the end of the paper which provide more information on the dataset. They show that the various controls used in the analysis have broad support in both categories of education (general and specific) which is encouraging for the regression analysis. Note that not all observations have information on all the listed variables.

[4]Belgium, China, Colombia, Czech Republic, Denmark, Egypt, France, Georgia, Germany, Greece, Guatemala, Hungary, Ireland, Israel, Italy, Luxembourg, Panama, Poland, Romania, Russia, Serbia, Slovak Republic, South Africa, Spain, Switzerland, Taiwan, United Kingdom, United States, Uruguay.

[5]Belgium, China, Colombia, Germany, Guatemala, Hungary, Ireland, Italy, Luxembourg, Russia, United Kingdom, Uruguay.

For the skill choice analysis I also use unemployment data from the Statistical Office of the European Communities (Eurostat) the OECD and from the World Bank. Observations start from 1955 and data availability varies by country. In the German case study, Eurostat data are used starting in 1983.

5 Empirical Methodology

The adaptation of the theoretical model to the data is not trivial . First of all, while the model deals with on the job training, this information is absent from the LIS dataset. A proxy thus needed to be identified – I chose formal education prior to starting work. This approach has multiple advantages and is compatible with the basic logic of the model. Formal education is an important, well-defined, and well-observed means of human capital acquisition. While vocational education prepares a student for more than just one specific job with one specific firm, a clear opposition can still be drawn with more general education. Even if specific (vocational) education provides skills applicable to a range of jobs within a specific field or occupation, it is nonetheless aimed at providing a more focused set of skills applicable to a smaller range of jobs than similar general (academic) education. As such, the basic trade-off of investing in specific or general skills is maintained. In the limit case where one chooses to acquire skills specific to a dying industry, vocational education actually becomes equivalent to the specific training used in the model. In the modern economy characterized by rapid change, an increasing number of jobs might fit this description (Krueger and Kumar, 2004, discuss this at length).

Even though investment in formal education is usually one-shot regardless of whether the program chosen is generalist or vocational, workers who acquired specific skills which became obsolete after a job change will most likely need to invest in retraining in one form or another. This is analogous to the model's concept of having to repay investment costs upon job change if specific skills were previously chosen.

As the model is stationary it assumes that any particular agent would repeat his choice of either specific or general training in any subsequent job (this is unnecessary in the case of general training as it carries on from job to job; however, if the agent had to choose again, he would still repeat his choice). One can extend this logic one stage backwards, from the first job to formal education which precedes it. There is little reason to suspect that an agent who would choose specific training in his first (and every other) job would choose general education before taking up this job and vice versa. This is especially true if one assumes, as does the theoretical model, that the choice of general or specific skill investment does not influence the probability of finding a job, just productivity once employed.

Still, the analogy is not perfect – choosing vocational training before having secured a job presumably has other effects on the worker's job market prospects than simply increasing his productivity for work in his area of specialization. On the one hand, the range of jobs available is likely lower than those available to a generalist and thus the job-finding rate might be lowered. This would act to mitigate the benefits of vocational education compared to the decision to undergo specific on-the-job training. On the other hand, the job-finding rate might also be affected in the opposite direction. For example, if vocational education providers have ties to industry requiring the specific skills acquired during the formation, it might facilitate entry to the job market. The direction of the bias, if any, introduced by using this proxy for on-the-job training is unclear.

Further issues that had to be resolved include limited data on individual heterogeneity in the LIS dataset and identifying a proxy for the level of market frictions embodied by the job-finding rate in the model which are used by agents to decide which type of skills to acquire. As in this case there is no silver bullet, multiple robustness checks are used to verify the integrity of the results.

5.a Job Tenure Analysis

The first part of the empirical section of this paper tests the prediction from the theoretical model that agents who choose to invest in specific skills can expect to hold their jobs for longer than agents who choose to invest in general skills.

Taking the theoretical model literally, one would predict that the expected job tenure for individuals who invested in specific skills would be common to all such individuals and would constitute an upper bound on expected job tenure of agents who invested in general skills (whose expected tenure would be an increasing function of their talent). However, any model is necessarily a simplification of reality and must be understood as such. Moreover, the present analysis is only one of the possible applications of the core intuitions of the model.

The model assumes that relevant individual heterogeneity is captured by a single dimension – talent. Even if this were true, talent, unfortunately, is unobservable to the researcher. Furthermore, the LIS dataset has few proxies for it, apart from parental education which is a very imperfect measure of an individual's talent and still only available in certain waves of the survey. This limits the usefulness of this aspect of the model beyond a theoretical justification of including some measure of individual heterogeneity - available individual characteristics in this case - and to predicting the direction of the bias, if talent were not properly controlled for.

While the theoretical model in essence only contains one "kind" of a job governed by the same productivity shock distribution, in reality various sectors, industries, and occupations may be associated both with a certain skill-mix requirement and with different average job durations which could bias the results. Supplementary control variables are introduced into the empirical model to account for this possibility.

Finally, the data only contain information on tenure in the current job. Thus it is censored in the sense that the reported number is a lower bound on the final tenure in this job. However, as the data are a random sample of the population, this issue should affect agents who choose general or specific education symmetrically and also irrespective of any other of their individual attributes. Thus beyond acknowledging that the tenure numbers presented in this paper likely understate final job tenure, this issue is not explored further.

The main equation for the tenure analysis is:

$$\begin{aligned} tenure = \beta_0 + \beta_1 * general\_education + \beta_2 * age + \beta_3 * sex + \beta_4 * marital\_status + \\ + \beta_5 * industry + \beta_6 * occupation + \beta_7 * firm\_size + \beta_8 * year + \epsilon \end{aligned} \tag{26}$$

The coefficient of interest is β_1 which captures the effect of choosing to invest in general rather than specific skills (via formal education) on average job tenure. The general education variable is a dummy which takes on the value of 1 if the individual chose education meant to impart predominantly general skills and the value of 0 if he chose education meant to impart predominantly specific skills. The demographic variables – age, sex, and marital status are meant to capture the effects of individual heterogeneity. Parental education and immigrant status are added in the German case study.[6] The industry, sector, occupation, and firm-size variables are meant to account for the fact that, unlike in the theoretical model presented above, in the real world there are fundamentally different types of jobs which are likely to have different mean job tenures. To the extent that these job types are disproportionately associated with either general or specific training, the omission of these controls would bias the results. The yearly trend variable meant to capture any spurious correlation between the autonomous evolution of the mix of general and specific education in the population and of average job tenure.[7] Finally ϵ is the error term.

I have described the sample selection strategy in Section 4 above. I believe that looking at regular, full-time workers in the private sector is the most appropriate in the context of the model. Public sector jobs have their own dynamics as do internships, entrepreneurial activity and other types of "irregular" work contracts. While I consider this "restricted" sample strongly preferable to the "full" one and its results more accurate, I still include the latter in robustness checks for full transparency.

The obtained results can only be ascribed a causal interpretation if the variable of interest (choosing specific or general education) is not related to any omitted variables which also influence job tenure – i.e. the correlation between the general education dummy and the model's error term is zero. If one takes the theoretical model seriously, he can easily see that this assumption does not hold. Unobserved talent influences both the choice of skill investment and the length of job tenure (at least for general skills) yet it is only imperfectly proxied for. Then again, if one believes the model, talent should both push individuals towards general education and increase their average job duration. Thus one can predict the direction of the bias and interpret the results with this information in mind. The omission of the talent variable should, in itself, artificially decrease the measured effect of specific skill investment on increasing expected job tenure. Thus, if the empirical results show that specific skills are indeed associated with longer job tenure despite the omission of the talent variable, one can treat the coefficient as a lower bound on the true effect. However, one should be careful about ascribing a causal interpretation to these results. As mentioned in the introduction, the aim of this paper is to provide an initial examination of whether the core intuitions of the model hold broadly in an international context. Based on this paper's initial findings, further research using one or two more detailed national datasets would be useful.

5.b Skill Choice Analysis

The second part of the empirical section of this paper tests the prediction from the theoretical model that agents' choice of investing in specific or general skills will depend on market frictions represented by the job finding rate. The model predicts that as the job finding rate falls, more individuals should want to invest in specific skills as they have a high motivation to keep any job they find. Furthermore, for any given job-finding rate, more talented individuals will tend towards general education and less talented ones towards specific education.

[6]They are only used as a robustness check in the main international analysis as this information is not available for all countries.

[7]Yearly dummies for each survey wave were included as a robustness check (unreported) without altering the results.

The same caveats mentioned in the previous section apply here regarding the adaptation of the predictions from the theoretical model to a form amenable to empirical testing in the real world. However, compared to the previous section, several additional challenges emerge. First, a proxy for the job finding rate is necessary for this analysis. The headline unemployment rate is used for this purpose. When unemployment is high, jobs are likely hard to come by and thus the job-finding rate is low. As a consequence, high unemployment should, all else equal, encourage investment in specific skills according to the theoretical model's predictions. The unemployment rate also seems like a reasonable proxy as it is a widely disseminated and discussed statistic and thus one which people might use in their decision making. However, as with any proxy, challenges remain. For instance, apart from its structural component related to market frictions, unemployment also varies with the economic cycle. This is not addressed in the static theoretical model. As by choosing which type of education to go through people make a long-term decision, they should look past these temporary ups and downs. They might thus consider a longer-term average of unemployment. This could, *inter alia*, allow them to look beyond temporary variations in unemployment caused by the business cycle. They can thus focus on the deep structural unemployment rate which reflects underlying frictions on the market and most closely resembles the parameter of interest from the theoretical model. In the empirical analysis, the 5-year mean of unemployment is the preferred statistic while the 3-year mean and the current value of unemployment are used in robustness checks.

As the dependent variable is binary in this case (choice of investment in either general or specific skills), a simple linear regression is not appropriate. Instead, the logistic regression is used.[8]

The main equation for the tenure analysis is:

$$P(general\_education) = \left(\frac{exp(X_i'\beta)}{1 + exp(X_i'\beta} \right) \tag{27}$$

Here X_i includes all the relevant covariates. The explanatory variable is the 5-year mean of the headline unemployment rate at age 15 - the assumed decision age for the choice between general and specialized education. The demographic variables – sex, citizenship status, and parents' education are meant to capture the effects of individual heterogeneity. Only variables which are known at the relatively young decision-age are used. The year of birth is included as an additional control and functions like a trend variable. It is closely related to the dummies for the decade in which each agent had to make the decision to invest in either general or specific skills. These controls are meant to capture any autonomous tendency towards either type of skill investment (over time, general skills seem to be more privileged in Germany for example) as well as any time-specific "fad" (which would be captured by the decade dummies). However, they also run the danger of capturing the long-term underlying evolution in unemployment - they could thus capture part of the effect of market frictions on skill choice.

Overall, the endogeneity concern in the skill choice analysis has shifted compared to the job tenure analysis presented above. As the explanatory variable is now a macro variable (the unemployment rate), it is not likely to be related to any individual characteristics. Thus even if there are omitted variables in the choice equation (again take talent for example) these are plausibly unrelated to the variable of interest and thus should not bias its coefficient. However, it is not unimaginable that there are additional macro variables which influence the decision to either go through vocational

[8] A regular regression was performed as a robustness check without altering the results.

or general education and which are also related to the unemployment rate. Any general tendency should be captured through the trend variable whereas any temporary change in policy or tastes should be, at least imperfectly, captured through the decade dummies. However, a range of potential confounding omitted variables remains – for example the standard of living, the rate of technological change, etc. Their exploration is left for future research.

6 Empirical Results

6.a International Comparison

6.a.i Job Tenure Analysis

Table 1 presents the results for the preferred regression using all countries in the LIS database which have sufficient information on prior education, on job tenure, and on the required controls. It uses over 36,000 observations from 8 countries on regular full-time private sector jobs held by non-disabled agents as this context seems the most appropriate for testing the theoretical model. The regression includes controls on demographics, employee role, firm size, and industry. The demographics contain the age at the start of employment[9] to avoid a spurious negative correlation between investment in general education and job tenure if specific education and general education entail systematic differences in years of schooling. The preferred regression also contains country fixed effects and a trend variable. The results suggest that choosing general education reduces expected job tenure by approximately 10 months, a non-negligible amount given mean job tenure of 10 years in the sample.

Table 2 adds dummies for the level of education received (secondary or tertiary) as well as an interaction term of the level of education with its type (general or specific). It further breaks down the sample into different age groups: the young workers fresh out of the schooling system and the older workers. The intuition is that "specific" education will likely be more specific to a job early on in one's career and may also form a relatively large part of the worker's human capital. This resembles quite closely the set-up from the theoretical model where skills are either fully specific or fully general and the agent's investment constitutes the entirety of his human capital. As a worker gains experience and progresses through his career, the formal education he received prior to starting work is likely to be less specific to the tasks he faces. By that time, a large part of his human capital relevant to the job at hand may have been acquired on the job. Thus his observed general or specific education is likely to be a less relevant proxy for the acquisition of general or specific skills figuring in the theoretical model. Thus one would expect to find that the specificity of education has a more pronounced impact on younger workers relative to older ones.

This intuition is supported by the data. The impact of general education is negative and significant at 1% for workers below 30 years of age whereas it is insignificant for those above 45 years old. This result is robust to changes around the age thresholds.

Table 3 shows additional robustness checks related to control inclusion and sample selection. The first 7 columns gradually add controls, starting with none in the first column. The 4 initial columns contain 4 additional countries compared to the preferred regression. They were previously

[9] When this information is missing for an observation, it is imputed based on the type of education attained.

excluded due to lack of information on firm size and employee role. Column 5 is the preferred regression. Column 6 adds controls for parents' education which limits the sample to 3 countries. These controls (as well as their interactions with education type) are insignificant. The last column extends the sample to part-time workers, the disabled, public employees, and other non-regular workers. All the specifications keep a negative coefficient on general education significant at 1%. The resulting impact on job tenure remains economically significant and varies between 6 months and 2 years.

6.a.ii Skill Choice Analysis

As the dependent variable is a binary choice between investment in general skills (through choosing general academic education) and specific skills (through choosing specific vocational education), this analysis relies on the logistic regression. The presented coefficients are marginal effects calculated for an average individual in the used sample. The variable of interest is the headline unemployment rate and its role in the agents' decision whether to specialize or not. All specifications include the year of birth for each individual meant to capture any time trend in skill type preference. They also contain dummies representing the decade in which he had to choose what type of skills to invest in to control for time-limited "fads". I consider them important for controlling for potential endogeneity even at the risk of capturing a part of the effect of market frictions on skill choice.

Table 4 presents the results for the preferred regression using all countries in the LIS database which have both sufficient information on prior education and on the required controls. It uses over 200,000 observations from 20 countries. The preferred sample for the skill choice analysis is broader than the preferred sample in the job tenure analysis. Given that the relevant choice here takes place before entry into the job market, restrictions on labor market variables make no sense. Thus only those still in education are excluded as they might not yet have made their final choice between general and specific education. The chosen explanatory variable is the 5-year mean of the headline unemployment rate in each country at the time of an agent's decision. The regression includes controls on demographics, dummies for the decade in which each agent made his education choice, and country dummies. The results suggest that a 1% increase in the 5-year mean of the headline unemployment rate results in a 1.3% decrease in the probability of choosing general education for an average indivdual.

Table 5 shows additional robustness checks on the unemployment rate considered, on control inclusion and on sample selection. Whether the dependent variable is the 5-year mean, 3-year mean or just the current year's value of the headline unemployment rate, the main result is qualitatively unchanged. The same holds for the addition of parental education as controls and for removing citizenship status (the latter enables the inclusion of all countries available). Coefficients on parents with primary and secondary education are also negative and significant (parents with university education are the omitted category). If parental education is indeed related to the "talent" dimension in the theoretical model, than the coefficients have the expected sign (parents with university education are the omitted category). However, given the low availability of the variable in the data (which in any case remains at most an imperfect proxy for talent), these results should be viewed with caution. The estimated negative impact of market frictions (proxied for by the unemployment rate) on choosing to invest in general skills remains economically significant in all cases.

6.b Case Study: Germany

6.b.i The German Education System

The German school system is complicated and this brief overview will focus on aspects most relevant to the present analysis. The German school system is regulated by 16 federal states so disparities exist. In general, there are 4 years of primary school. Afterwards students make a choice of secondary school between “Hauptschule”, “Realschule”, and “Gymnasium”. The choice is influenced by a performance-based primary school teacher’s recommendation but generally this recommendation is non-binding and the pupil and his parents can still decide where to go. Thus at the age of 9 or 10 the first decision regarding future education is made.

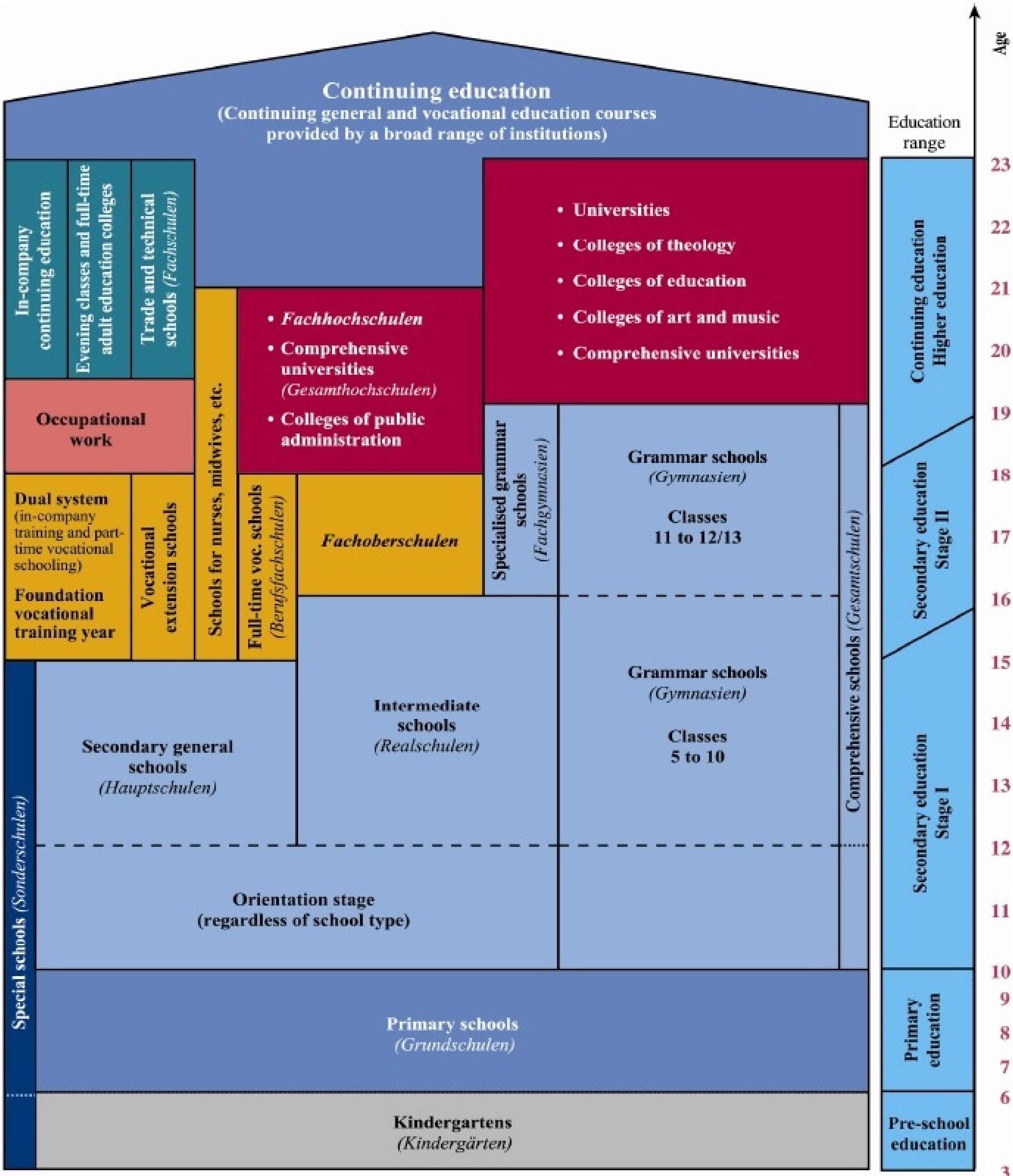
Good students get a recommendation for the Gymnasium. It prepares them for the “Abitur” examination which qualifies them for university. After year nine, Gymnasium pupils automatically have the “Hauptschulabschluss” (the equivalent of “basic secondary general education” in the data), after year ten they have the “Realschulabschluss” (equivalent of “basic secondary general education, 1st stage in the data”). Afterwards, they start their preparation for the Abitur which takes two years (11 and 12). They will be ready for general university education at age 17 or 18. Alternatively, after year 10 instead of doing the Abitur, students can also do the “Fachabitur”/“Fachoberschule”. This is like Abitur combined with an orientation towards a profession or a specific field. As such it is somewhere between general and vocational training. It does not qualify for all universities and is mainly geared towards a university of applied science and arts (“Fachhochschule”). Students can also do a vocational education (“Ausbildung”) after each stage.

Realschule is a little “easier” than Gymnasium. After finishing Realschule, pupils are prepared to start a vocational education after year 10, at the age of 15 or 16. If they have satisfactory grades, they can also decide to change school to a Gymnasium at this time and get the Abitur.

Hauptschule is the most practical form of secondary schooling, preparing directly for a vocational training after school. It includes more practical subjects and job orientation as well. After year nine, at age 15, its students can also change school and finish at a Realschule or Gymnasium.

Finally, there are certain state-specific alternative school types available but those are beyond the scope of the present overview.

The following picture illustrates the above



Source: Hippach-Schneider et al. (2007)

In summary, students decide between a path geared towards the acquisition of general or specific skills as early as age 10. This decision is partly based on a performance-based recommendation from their primary school teacher. The second decision node comes around age 15/16 where students can choose to either continue with general education, to switch to vocational training, or – if they were previously in a more vocational track – to get a general degree instead. Finally, around age 17/18 students can choose whether to get a general university education or a more practical/vocational post-secondary training.

Given the classification present in the German data (see **Figure 4** in the "Tables and Figures" section at the end of the paper) of the LIS database and the aforementioned features of the German education system, my preferred classification into general and specific education is as follows: The educational choices are separated into two categories of approximately equivalent level: high school and university. The high school general category contains education classified as "secondary general education". The high school specific category contains education classified as "secondary general + vocational education". The university general category contains education classified as "higher education". The university specific category contains education classified as "higher vocational".

Multiple robustness checks regarding the classification of education in Germany between general and specific are presented. On the high school level they consist of adding "basic" and "upper" secondary education, education classified as "other", and switching one ambivalent category (Fachobershule) from general to specific even though it is coded as "secondary general education". The last robustness in classification (switching Fachoberschule to specific high school education) is motivated by my knowledge of the actual structure of the German schooling system and might have been my preferred classification if it weren't described as general in the data.

On the university level the robustness adds the "upper secondary general + vocational education" into the university specific classification as this can also be viewed as post-secondary education. This should approximately match university education in terms of years of schooling and thus provide a reasonable counter-factual.

6.b.ii Job Tenure Analysis

Tables 6 presents the results for the preferred regression for Germany. It uses over 6,000 observations on regular full-time private sector jobs held by non-disabled agents as this context seems the most appropriate for testing the theoretical model. The regression includes controls on demographics, parental education, employee role, firm size, and industry. The inclusion of parental education is the only difference with the international analysis on job tenure presented above. The variable is available for both the 2007 and 2010 survey waves. As before, demographics contain the age at the start of employment to avoid a spurious negative correlation between investment in general education and job tenure if specific education and general education entail systematic differences in years of schooling. Finally, the preferred regression also contains a trend variable. The results suggest that choosing general education reduces expected job tenure by over 2 years, a significant amount given mean job tenure of 11.5 years in the German sample.

Table 7 breaks down the sample into different age groups, analogously to **Table 2** from the international analysis. It separately studies workers with finished secondary and tertiary education. The results are in line with both the theoretical model and the international analysis presented in *Section 6.a.i.* The impact of general education is negative and significant for workers below 30 years of age and insignificant for those above 45 years old both for workers with high school and university education. This result is robust to changes around the age thresholds.

Table 8 tests robustness of the results to changes in classification of education into general and specific based on the analysis of the German education system presented in the previous subsection. The coefficient of interest remains qualitatively unchanged. The negative effect of general education compared to specific education on job tenure is significant in all cases.

Tables 9 and 10 show additional robustness checks related to control inclusion and sample selection for the university and high school samples respectively. The first 5 columns of each table gradually add controls, starting with none in the first column. Column 4 which has the full set of controls apart from parental education is analogous to the preferred specification from the international analysis presented in **Table 1**. The last column extends the sample to part-time workers, the disabled, public employees, and other non-regular workers. All the specifications keep a negative and significant coefficient on general education apart from Column 6 of **Table 10** which is no longer significant.

6.b.iii Skill Choice Analysis

Table 11 presents the results for the preferred regression for Germany. It uses over 4,000 observations. The preferred sample is selected analogously to that in the international skill choice analysis: only those still in education are excluded. The chosen explanatory variable is the 5-year mean of the headline unemployment rate at the time of an agent's decision. The regression includes controls on demographics, parental education and dummies for the decade in which each agent made his education choice. The results suggest that a 1% increase in the 5-year mean of the headline unemployment rate results in a 2.7% decrease in the probability of choosing general education for an average agent. Coefficients on parents with primary and secondary education are negative and significant, in line both with results from the international analysis and the intuition from the theoretical model.

Table 12 shows additional robustness checks on the unemployment rate considered, and on sample selection. Similarly to the international analysis presented above, whether the dependent variable is the 5-year mean or the 3-year mean of the headline unemployment rate, the main result is qualitatively unchanged. However, this time the current year's value of unemployment has an insignificant coefficient. This is not particularly surprising as rational agents can be expected to use information from more than the current year in their decision making (looking for information on the longer-term job-finding rate, rather than for a temporary fad). The coefficients on parents with primary and secondary education remain negative and significant in all cases.

7 Discussion

The results presented above provide initial support for the main predictions of Wasmer (2006) modified here to include individual heterogeneity. They imply that individuals are more likely to invest in specific rather than general skills when labor market frictions are high and that this investment results in an increased job tenure. They hold both in the high-level international analysis covering almost 30 countries and the more in-depth German case study. They are largely robust to included controls, the considered proxy for market frictions, and, in the German case, also to education level and classification. The findings suggest the possible presence of a deeper underlying economic mechanism and hold promise for future research. They are also of a non-negligible magnitude - both in percentage and absolute terms.

Nevertheless, multiple caveats are associated with these analyses. While the theoretical model deals explicitly with on the job training, due to lack of available data formal education is used as a proxy. Even though this is compatible with the underlying logic of the model and constitutes an important means of human capital acquisition, the two clearly are not the same. The empirical analysis thus needs to be understood as only one of the possible applications of the core intuitions of the model. In the skill choice analysis, the headline unemployment rate is chosen to proxy for for the degree of job market frictions which affect the job-finding rate in the model. It is a widely known macroeconomic statistic and should be negatively correlated with the job finding rate. The unemployment rate at the moment of each agent's decision as well as its various averages over time are tested. This takes into account the fact that in choosing which type of education to go through people make a long-term decision. Considering a multi-year average of unemployment allows them to look beyond temporary variations caused by the business cycle. They can thus try to identify the deep structural unemployment rate reflecting underlying frictions on the market which most closely resembles the parameter of interest from the theoretical model.

Both the theoretical model and the empirical specification are sparse. In reality, other macro-level factors are likely to influence the decision on which type of human capital to invest in. Thus, in the empirical analysis I include a trend variable to take into account any autonomous long-term trend in skill choice investment and decision-decade dummies which should capture more temporary influences. However, they might also capture a part of the effect of market frictions and thus dilute the obtained results.

It is important to keep in mind that the general/specific skill variable is necessarily imprecise. While the theoretical model distinguishes between purely specific and general skills, in reality no skill is purely specific or purely general. This is akin to having the variable of interest measured with some amount of error. I include robustness checks using alternative education classifications in the German case study. While it is encouraging that the results hold across the specifications in this case, a similar exercise with other countries should be conducted but is beyond the scope of this paper.

Potential endogeneity also remains a concern. The theoretical model predicts that both job tenure and skill choice will be influenced by an individual's talent. This is unobserved to the researcher. It is likely to be a bigger issue in the job tenure analysis as it is predicted to be related both to the variable of interest (job tenure) and to the explanatory variable (choice of type of skill investment). I attempt to control for it using available demographic information but have no illusion that the controls at my disposal are perfect. As the empirical analysis is based on a theoretical model, one can predict the direction of the bias, should it exist (nevertheless, the model necessarily remains a simplification of reality so this exercise has its limits). In this case, theory and empirics have been kind to the researcher. Theory says that individuals with more talent should tend to both choose to invest in general skills and to have longer expected job tenure. The empirical results suggest that individuals who choose general education have lower expected job tenure, by about 1 to 2 years. If their talent is imperfectly controlled for and positively correlated with choosing to invest in general skills, the estimated effect should represent a lower bound on the negative effect of general skill investment on job tenure compared to having invested in specific skills.

Moreover, it is encouraging that the model's predictions hold for the part of the sample which is most similar to the setting of the model - for individuals early in their careers for whom their chosen "specific" education might actually be specific to the job they currently hold and may also form a relatively large part of their human capital. Conversely, education specificity does not seem to impact job tenure of older workers which seems reasonable as they may have long ago changed their career orientation and acquired a large part of their human capital outside of the context of formal education. If individuals choosing the two types of training were fundamentally different in unobserved ways and these unobserved differences were driving the results rather than their choice of specific or general education, we should observe this "spurious" finding in both samples. This is not the case.

For the skill choice analysis, unobserved talent should be less of a problem as it is not related to the explanatory variable – the unemployment rate. However, endogeneity may come from elsewhere, notably ongoing time trends, fads, changing policies encouraging one type of education or the other, or other macro variables like the growth rate of the economy, the rate of technological change, etc. These are absent from the simple theoretical framework presented in *Section 3*. That is why I include the year of birth to control for any long-term trend favoring the acquisition of one type of skill over the other and dummies for the decade during which each individual had to make his decision to control for any time-limited changes in tastes or policy. Still, the included controls cannot guarantee a complete elimination of omitted variable bias. It is up to the reader to decide whether the results presented in this paper should be treated as causal effects confirming an underlying economic mechanism or simply as interesting correlations which should be explored further in future research.

8 Conclusion

This paper tests the core predictions of Wasmer (2006) on the determinants and labor market effects of the decision to invest in specific versus general human capital. Its predictions, if confirmed, would shed new light on the age-old question of differential labor market performance in the United States and in Europe. The first part of the paper contains an extension of the model of Wasmer (2006) introducing individual heterogeneity. This leads to a coexistence of individuals with a strict preference for acquiring either specific or general skills at any given point in time and in any given labor market environment. The second part of the paper empirically tests the main the predictions of the model: first, that individuals who invest in specific rather than general skills should be more productive and thus, *ceteris paribus*, have a longer expected job tenure; second, that people should be more inclined to invest in specific rather than in general skills, *ceteris paribus*, in a labor market with high frictions and thus a low job finding rate. The aim of the empirical analysis is to provide an initial examination of whether the theory fits the data. The LIS database was chosen as it contains standardized information from dozens of countries and yet remains a thus far largely understudied dataset in this literature. While the obtained results cannot constitute a definitive proof of the validity of the theory, they certainly do not contradict the model. In fact, they show broad support for its central predictions and should encourage further research.

The outcome from the job tenure analysis suggests an approximately 1- to 2-year increase in average job tenure when choosing to invest in specific rather than general skills. Given mean job tenure in my sample, this corresponds to an approximately 10 to 20% increase, a non-negligible amount by any standard. The result is largely robust to education level (high school or university) and controls included. It holds both in the big picture international analysis and in the more in-depth German case study. Assuming that the predictions of the theoretical model hold and that talent is only imperfectly controlled for, these results should be taken as a lower bound on the actual impact of choosing to invest in general rather than specific skills on expected job tenure.

The outcome from the skill choice analysis is similarly promising. The analysis required identifying a proxy for labor market frictions which drive the job-finding rate in the model (which is in turn used by individuals to decide on the type of skills that they want to invest in). Finally the 5-year average of the headline unemployment rate was chosen for the preferred specification. It makes intuitive sense as it should allow agents to look beyond temporary fluctuations in unemployment to identify the deep structural unemployment rate. This reflects underlying frictions on the labor market and most closely resembles the parameter of interest from the theoretical model. A 1% increase in the 5-year mean of the headline unemployment rate is associated with an approximately equivalent reduction in the probability of choosing to invest in general rather than specific skills for an average individual.

These results, if confirmed in future research, have potentially broad implications. Notably, they may contribute another piece to the EU-US labor market performance puzzle. Workers in relatively rigid European labor markets may be induced to invest disproportionately in specific skills and thus be more productive, keeping their jobs longer at the cost of being less adaptive to change. This can be beneficial in calm times but less advantageous in periods of rapid transformation. The understanding of the mechanism driving the decision to specialize or not and of its implications for worker performance can thus be important both to the design of education and labor market policy.

Future research can take a couple of directions. The first, and most important, step should be a more extensive treatment of possible endogeneity concerns using detailed time-series data, ideally including information on actual on the job training rather than formal education. Information on worker productivity would be helpful to confirm that the observed increase in job tenure is indeed driven by improved worker performance on the job. For the skill choice analysis, an inclusion of a larger set of macro-economic controls should be examined. An in-depth analysis of US data and a large European country like Germany or France would enable a more informed discussion of the implications of the theoretical and empirical findings on Europe-US labor market differences. Second, additional proxies for the variable of interest from the theoretical model in the skill choice analysis should be explored. Third, further extensions of the theoretical model could be fruitful. Potential avenues include: the relaxation of the assumption of purely general or specific human capital, incorporating the possibility of acquiring varying levels of human capital, considering the effect of general or specific skills on the job finding rate, and considering the effect of macro variables like growth on the general-specific skill mix in equilibrium. Finally, the policy implications of the present findings should be carefully analyzed.

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10 Tables And Figures

Figure 1
Country Breakdown

		Observations	Survey Waves	Specific Education	General Education
Country	Belgium	1,436	2000	48%	52%
	China	7,195	2002	42%	58%
	Colombia	19,701	2004, 2007, 2010, 2013	49%	51%
	Czech Republic	47,192	1992, 1996, 2007, 2010, 2013	80%	20%
	Denmark	261,818	2007, 2010, 2013	83%	17%
	Egypt	8,980	2012	93%	7%
	France	59,635	1978, 1984, 1989, 1994, 2000, 2005, 2010	76%	24%
	Georgia	14,606	2010, 2013	34%	66%
	Germany	72,321	1984, 1989, 1994, 2000, 2004, 2007, 2010	73%	27%
	Greece	21,375	2007, 2010, 2013	25%	75%
	Guatemala	3,193	2006	24%	76%
	Hungary	5,842	2005, 2007, 2009, 2012	51%	49%
	Ireland	5,953	2007, 2010	26%	74%
	Israel	24,610	2001, 2005, 2007, 2010, 2012	33%	67%
	Italy	31,110	1998, 2000, 2004, 2008, 2010, 2014	22%	78%
	Luxembourg	8,752	2000, 2007, 2010, 2013	72%	28%
	Panama	31,140	2007, 2010, 2013	10%	90%
	Poland	226,124	1999, 2004, 2007, 2010, 2013	72%	28%
	Romania	60,663	1995, 1997	47%	53%
	Russia	13,275	2000, 2004, 2007, 2010, 2013	60%	40%
	Serbia	21,852	2006, 2010, 2013	83%	17%
	Slovak Republic	7,796	2010	63%	37%
	South Africa	17,890	2008, 2010, 2012	1%	99%
	Spain	2,678	2000	52%	48%
	Switzerland	17,677	1992, 2000, 2002, 2004	85%	15%
	Taiwan	102,665	1981, 1986, 1991, 1995, 1997, 2000, 2005, 2007, 2010, 2013	63%	37%
	United Kingdom	53,726	1999, 2004, 2007, 2010, 2013	15%	85%
	United States	338,265	1991, 1994, 1997, 2000, 2004, 2007, 2010, 2013	76%	24%
	Uruguay	18,678	2013	18%	82%
Total Obs		1,506,148			

Figure 2

Demographics Breakdown [1]

		Specific Education	General Education
Sex	Male	67%	33%
	Female	64%	36%
Married	Yes	62%	39%
	No	69%	31%
Citizen	Yes	69%	31%
	No	67%	33%
Disabled	Yes	66%	34%
	No	65%	35%
Parents Edu	None and Primary	40%	60%
	Secondary	58%	42%
	University	33%	67%

Notes:

[1] Sample includes data from all 29 countries analyzed in this paper and presented in **Figure 1**: Belgium, China, Colombia, Czech Republic, Denmark, Egypt, France, Georgia, Germany, Greece, Guatemala, Hungary, Ireland, Israel, Italy, Luxembourg, Panama, Poland, Romania, Russia, Serbia, Slovak Republic, South Africa, Spain, Switzerland, Taiwan, United Kingdom, United States, Uruguay.

Figure 3

Job and Education Breakdown [1]

		Specific Education	General Education
Overall		64%	36%
Employment	Yes	67%	33%
	No	62%	38%
Employment Type	Regular	68%	32%
	Short-Term	68%	32%
	Self-Employed	64%	36%
	Employer	46%	54%
Education Level	Secondary	62%	38%
	Tertiary	73%	27%
Part time	Yes	61%	39%
	No	66%	34%
Sector	Public	67%	33%
	Private	67%	33%
	Non-Profit	80%	20%
Occupation	Manager/Professional	63%	37%
	Skilled Worker	70%	30%
	Laborer/Elementary	66%	34%
Industry	Agriculture	70%	30%
	Industry	73%	27%
	Services	64%	36%
Firm Size	1-20	60%	40%
	21+	61%	39%

Notes:

[1] Sample includes data from all 29 countries analyzed in this paper and presented in **Figure 1**: Belgium, China, Colombia, Czech Republic, Denmark, Egypt, France, Georgia, Germany, Greece, Guatemala, Hungary, Ireland, Israel, Italy, Luxembourg, Panama, Poland, Romania, Russia, Serbia, Slovak Republic, South Africa, Spain, Switzerland, Taiwan, United Kingdom, United States, Uruguay.

Figure 4

Germany Classification of Education Data

Survey waves 1984-2010

| educ_c highest level of education: ISCED-1997-classification

N	code	label
3159	0	still in education
69	11	inadequately, other diploma
244	12	inadequately, left school without diploma
1642	21	basic secondary general education (Hauptschule)
866	22	basic secondary general education , 1st stage (Realschule)
256	23	basic secondary general education , other diploma
3827	31	secondary general + vocational education (Hauptschule plus Lehre)
501	32	secondary general + vocational education (Hauptschule plus Berufsfachschule)
79	33	secondary general + vocational education (Hauptschule plus other)
3053	34	secondary general + vocational education (Realschule plus Lehre)
869	35	secondary general + vocational education (Realschule plus Berufsfachschule)
96	36	secondary general + vocational education (Realschule plus other)
129	37	secondary general education (Fachoberschule)
664	38	secondary general education , 2nd stage (Abitur)
750	39	other secondary education
254	41	upper secondary general + vocational education (Fachoberschule plus Lehre)
113	42	upper secondary general + vocational education (Fachoberschule plus Berufsfachschule)
6	43	upper secondary general + vocational education (Fachoberschule plus other)
454	44	upper secondary general + vocational education (Abitur plus Lehre)
164	45	upper secondary general + vocational education (Abitur plus Berufsfachschule)
43	46	upper secondary general + vocational education (Abitur plus other)
152	49	other upper secondary education + vocational training
174	51	higher vocational (Gesundheitswesen)
1120	52	higher vocational (Fach/Meisterausbildung)
97	53	higher vocational (Beamtenausbildung)
4495	61	higher education
3676	.	

Table 1 - International Comparison

General v. Specific Education

Tenure Analysis [1]

	(1) Dependent Variable: Tenure in Current Job (years)
General Education	-0.870 ***
	(0.112)
Demographics [2]	✓
Controls for Industry [3]	✓
Controls for Firm Size and Employee Role [4]	✓
Country Dummies	✓
Yearly Trend	✓
Observations	36,559
R-squared	0.324

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Sample excludes the unemployed and those still in education; part-time workers; the disabled; public employees; and all non-regular workers. Includes data from Belgium, Germany, Guatemala, Ireland, Luxembourg, Russia, the UK, and Uruguay.

[2] Includes age, sex, marital status, and age of entry into employment.

[3] Dummies for industry category: industry, agriculture, services.

[4] Dummies for firm size: 1-20 workers and 20+ workers. Dummies for employee position: elementary worker, skilled worker, manager and professional.

Table 2 - International Comparison

General v. Specific Education

Tenure Analysis by Education Level and Age [1]

	(1)	(2)	(3)
		Dependent Variable: Tenure in Current Job (years)	
General Education	-0.317 **	-0.404 ***	-0.445
	(0.139)	(0.093)	(0.337)
Education Level	-0.413 ***	-0.479 ***	-0.553
	(0.161)	(0.156)	(0.362)
Education Level * General	-1.020 ***	-0.684 ***	-0.792
	(0.222)	(0.192)	(0.519)
Demographics [2]	✓	✓	✓
Controls for Industry [3]	✓	✓	✓
Controls for Firm Size and Employee Role [4]	✓	✓	✓
Country Dummies	✓	✓	✓
Yearly Trend	✓	✓	✓
Age Category	all	<30	>45
Observations	36,559	7,847	12,325
R-squared	0.323	0.224	0.110

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Sample excludes the unemployed and those still in education; part-time workers; the disabled; public employees; and all non-regular workers. Includes data from Belgium, Germany, Guatemala, Ireland, Luxembourg, Russia, the UK, and Uruguay.

[2] Includes age, sex, marital status, and age of entry into employment.

[3] Dummies for industry category: industry, agriculture, services.

[4] Dummies for firm size: 1-20 workers and 20+ workers. Dummies for employee position: elementary worker, skilled worker, manager and professional.

Table 3 - International Comparison

General v. Specific Education

Tenure Analysis: Additional Robustness [1]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Variable: Tenure in Current Job (years)							
General Education	-1.295 ***	-0.943 ***	-0.569 ***	-0.538 ***	-0.870 ***	-1.820 ***	-1.292 ***	-0.573 ***
	(0.072)	(0.089)	(0.085)	(0.086)	(0.112)	(0.259)	(0.134)	(0.077)
Demographics [2]			✓	✓	✓	✓	✓	✓
Controls for Industry [3]				✓	✓	✓	✓	✓
Controls for Firm Size and Employee Role [4]					✓	✓	✓	✓
Controls for Parent's Education [5]						✓		
Country Dummies		✓	✓	✓	✓	✓	✓	✓
Yearly Trend			✓	✓	✓	✓	✓	✓
Citizenship Status							✓	
Extended Sample [6]								✓
# of Countries Included	12	12	12	12	8	3	7	9
Observations	71,390	71,390	66,963	65,738	36,559	7,526	29,571	69,678
R-squared	0.004	0.044	0.342	0.345	0.324	0.337	0.342	0.352

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Sample excludes the unemployed and those still in education; part-time workers; the disabled; public employees;
and all non-regular workers. Includes data from Belgium, China, Colombia, Germany, Guatemala, Hungary, Ireland, Italy, Luxembourg, Russia, the UK, and Uruguay.

[2] Includes age, sex, marital status, and age of entry into employment.

[3] Dummies for industry category: industry, agriculture, services.

[4] Dummies for firm size: 1-20 workers and 20+ workers. Dummies for employee position: elementary worker, skilled worker, manager and professional.

[5] Dummies for parents' education: non and primary, secondary, tertiary education.

[6] Sample includes part-time workers, the disabled, public employees, and other non-regular workers.

Table 4 - International Comparison

General v. Specific Education

Skill Choice [1]

	(1) Dependent Variable: Choice of General vs. Specific Education
5-year Mean of Unemployment rate	-0.013 ***
	(0.001)
Demographics [2]	✓
Decade Dummies	✓
Country Dummies	✓
Observations	217,871
Pseudo R-squared	0.190

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Includes all individuals who are not currently enrolled in education. Logistic regression: displayed coefficients are marginal effects for the average individual. Includes data from Belgium, Colombia, Czech Republic, Denmark, Egypt, France, Germany, Greece, Guatemala, Ireland, Israel, Italy, Luxembourg, Poland, Russia, Slovak Republic, South Africa, Spain, Switzerland, United States, Uruguay.

[2] Includes sex,citizenship status, and date of birth.

Table 5 - International Comparison
General v. Specific Education
Skill Choice Robustness [1]

	(1)	(2)	(3)	(4)	(5)
	Dependent Variable: Choice of General vs. Specific Education				
Unemployment rate	-0.013 ***	-0.007 ***	-0.006 ***	-0.027 ***	-0.005 ***
	(0.001)	(0.001)	(0.000)	(0.006)	(0.001)
Parental Edu Primary				-0.413 ***	
				(0.020)	
Parental Edu Secondary				-0.414 ***	
				(0.013)	
Demographics [2]	✓	✓	✓	✓	✓
Decade Dummies	✓	✓	✓	✓	✓
Country Dummies	✓	✓	✓	✓	✓
Unemployment Type	**5-year mean**	**3-year mean**	**current year**	**5-year mean**	**5-year mean**
# of Countries Included	21	21	21	8	28
Observations	217,871	264,275	276,605	25,938	265,713
Pseudo R-squared	0.190	0.187	0.1866	0.472	0.210

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Includes all individuals who are not currently enrolled in education. Logistic regression: displayed coefficients are marginal effects for the average individual. Includes data from Belgium, China, Colombia, Czech Republic, Denmark, Egypt, France, Georgia, Germany, Greece, Guatemala, Hungary, Ireland, Israel, Italy, Luxembourg, Panama, Poland, Romania, Russia, Serbia, Slovak Republic, South Africa, Spain, Switzerland, Taiwan, United Kingdom, United States, Uruguay.

[2] Includes sex,citizenship status, and date of birth. Citizenship status is excluded in the last column to show the full number of countries in the dataset.

Table 6 - Germany

General v. Specific Education

Tenure Analysis [1]

	(1)
	Full Controls
	Dependent Variable: Tenure in Current Job (years)
General Education	-2.363 ***
	(0.309)
Demographics [2]	✓
Controls for Industry [3]	✓
Controls for Firm Size and Employee Role [4]	✓
Controls for Parent's Education [5]	✓
Yearly Trend	✓
Observations	6,049
R-squared	0.322

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Sample excludes the unemployed and those still in education; part-time workers; the disabled; public employees; and all non-regular workers. The German data span the 1984-2010 survey waves.

[2] Includes age, sex, citizenship status, marital status, and age of entry into employment.

[3] Dummies for industry category: industry, agriculture, services.

[4] Dummies for firm size in 5 categories. Dummies for employee position: elementary worker, skilled worker, manager and professional.

[5] Dummies for parents' education: non and primary, secondary, tertiary education.

Table 7 - Germany

General v. Specific Education
Tenure Analysis by Education Level and Age [1]

	(1)	(2)	(3)	(4)	(5)	(6)
	Germany University			Germany High School		
	Dependent Variable: Tenure in Current Job (years)					
General Education	-1.642 ***	-1.776 ***	-0.649	-1.534 *	-1.591 **	-1.664
	(0.415)	(0.487)	(0.828)	(0.940)	(0.644)	(2.311)
Demographics [2]	✓	✓	✓	✓	✓	✓
Controls for Industry [3]	✓	✓	✓	✓	✓	✓
Controls for Firm Size and Employee Role [4]	✓	✓	✓	✓	✓	✓
Controls for Parent's Education [5]	✓	✓	✓	✓	✓	✓
Yearly Trend	✓	✓	✓	✓	✓	✓
Age Category	all	<30	>45	all	<30	>45
Observations	2,402	242	1,061	3,647	665	1,460
R-squared	0.355	0.206	0.149	0.313	0.201	0.122

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Sample excludes the unemployed and those still in education; part-time workers; the disabled; public employees; and all non-regular workers. The German data span the 1984-2010 survey waves.

[2] Includes age, sex, citizenship status, marital status, and age of entry into employment.

[3] Dummies for industry category: industry, agriculture, services.

[4] Dummies for firm size in 5 categories. Dummies for employee position: elementary worker, skilled worker, manager and professional.

[5] Dummies for parents' education: non and primary, secondary, tertiary education.

Table 8 - Germany

General v. Specific Education
Tenure Analysis Robustness to Classification [1]

	(1)	(2)	(3)	(4)	(5)	(6)
	Germany University		Germany High School			
	Dependent Variable: Tenure in Current Job (years)					
General Education	-1.642 ***	-1.786 ***	-1.534 *	-0.755 **	-0.735 **	-2.334 **
	(0.415)	(0.323)	(0.940)	(0.380)	(0.329)	(1.092)
Demographics [2]	✓	✓	✓	✓	✓	✓
Controls for Industry [3]	✓	✓	✓	✓	✓	✓
Controls for Firm Size and Employee Role [4]	✓	✓	✓	✓	✓	✓
Controls for Parent's Education [5]	✓	✓	✓	✓	✓	✓
Yearly Trend	✓	✓	✓	✓	✓	✓
Alternative Education Classification [6]	**base**	**R1**	**base**	**R1**	**R2**	**R3**
Observations	2,402	2,984	3,647	4,675	5,005	3,647
R-squared	0.355	0.367	0.313	0.336	0.334	0.313

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Sample excludes the unemployed and those still in education; part-time workers; the disabled; public employees; and all non-regular workers. The German data span the 1984-2010 survey waves.

[2] Includes age, sex, citizenship status, marital status, and age of entry into employment.

[3] Dummies for industry category: industry, agriculture, services.

[4] Dummies for firm size in 5 categories. Dummies for employee position: elementary worker, skilled worker, manager and professional.

[5] Dummies for mother's and father's education: non and primary, secondary, tertiary education.

[6] The preferred for university specification includes "higher education" in the general category and "higher vocational" in the specific category.
R1 adds the "upper secondary general + vocational education" category to the base specification.
The preferred specification includes "secondary general education" in the general category and "secondary general + vocational education" in the specific category.
R1 adds "basic secondary general education" to the general category and "upper secondary general + vocational education" to the specific category.
R2 also adds "other secondary education" to the general category and "other upper secondary general + vocational training" to the specific category.
R3 is like the preferred specification but switches "Fachoberschule" from the general category to the specific one.

Table 9 - Germany

General v. Specific Education

Tenure Analysis: University Robustness [1]

	(1)	(2)	(3)	(4)	(5)	(6)
	Germany University Dependent Variable: Tenure in Current Job (years)					
General Education	-2.161 ***	-2.311 ***	-2.1322 ***	-2.340 ***	-1.642 ***	-1.965 ***
	(0.242)	(0.244)	(0.212)	(0.229)	(0.415)	(0.293)
Demographics [2]			✓	✓	✓	✓
Controls for Industry [3]				✓	✓	✓
Controls for Firm Size and Employee Role [4]				✓	✓	✓
Controls for Parent's Education [5]					✓	✓
Yearly Trend		✓	✓	✓	✓	✓
Extended Sample [6]						✓
Observations	7,040	7,040	6,898	6,760	2,402	6,313
R-squared	0.011	0.015	0.313	0.342	0.355	0.369

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Sample includes workers with finished tertiary education. It excludes the unemployed and those still in education; part-time workers; the disabled; public employees; and all non-regular workers. The German data span the 1984-2010 survey waves.

[2] Includes age, sex, citizenship status, marital status, and age of entry into employment.

[3] Dummies for industry category: industry, agriculture, services.

[4] Dummies for firm size in 5 categories. Dummies for employee position: elementary worker, skilled worker, manager and professional.

[5] Dummies for parents' education: non and primary, secondary, tertiary education.

[6] Sample includes part-time workers, the disabled, public employees, and other non-regular workers.

Table 10 - Germany

General v. Specific Education
Tenure Analysis: High School Robustness [1]

	(1)	(2)	(3)	(4)	(5)	(6)
	Germany High School Dependent Variable: Tenure in Current Job (years)					
General Education	-4.172 ***	-4.384 ***	-1.782 ***	-1.729 ***	-1.534 *	-0.056
	(0.582)	(0.581)	(0.501)	(0.498)	(0.940)	(0.616)
Demographics [2]			✓	✓	✓	✓
Controls for Industry [3]				✓	✓	✓
Controls for Firm Size and Employee Role [4]				✓	✓	✓
Controls for Parent's Education [5]					✓	✓
Yearly Trend		✓	✓	✓	✓	✓
Extended Sample [6]						✓
Observations	14,209	14,209	13,912	13,417	3,647	7,482
R-squared	0.004	0.011	0.293	0.330	0.313	0.297

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Sample includes workers with finished secondary education. It excludes the unemployed and those still in education; part-time workers; the disabled; public employees; and all non-regular workers. The German data span the 1984-2010 survey waves.

[2] Includes age, sex, citizenship status, marital status, and age of entry into employment.

[3] Dummies for industry category: industry, agriculture, services.

[4] Dummies for firm size in 5 categories. Dummies for employee position: elementary worker, skilled worker, manager and professional.

[5] Dummies for parents' education: non and primary, secondary, tertiary education.

[6] Sample includes part-time workers, the disabled, public employees, and other non-regular workers.

Table 11 - Germany

General v. Specific Education
Skill Choice [1]

	(1)	
	Germany	
	Dependent Variable: Choice of General vs. Specific Education	
5-year Mean of Unemployment rate	-0.027	**
	(0.012)	
Parental Edu Primary	-0.568	***
	(0.042)	
Parental Edu Secondary	-0.438	***
	(0.017)	
Demographics [2]	✓	
Decade Dummies	✓	
Observations	4,057	
Pseudo R-squared	0.123	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Includes all individuals who are not currently enrolled in education. Logistic regression: displayed coefficients are marginal effects for the average individual.

[2] Includes sex, citizenship status and date of birth.

Table 12 - Germany

General v. Specific Education
Skill Choice Robustness [1]

	(1)	(2)	(3)
		Germany	
		Dependent Variable: Choice of General vs. Specific Education	
Unemployment rate	-0.027 **	-0.037 ***	-0.001
	(0.012)	(0.013)	(0.008)
Parental Edu Primary	-0.568 ***	-0.599 ***	-0.540 ***
	(0.042)	(0.035)	(0.038)
Parental Edu Secondary	-0.438 ***	-0.448 ***	-0.459 ***
	(0.017)	(0.016)	(0.014)
Demographics [2]	✓	✓	✓
Decade Dummies	✓	✓	✓
Skill Choice Sample [3]			
Unemployment Type	**5-year mean**	**3-year mean**	**current year**
Observations	4,057	4,903	6,373
Pseudo R-squared	0.123	0.121	0.1157

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] Includes all individuals who are not currently enrolled in education. Logistic regression: displayed coefficients are marginal effects for the average individual.

[2] Includes sex, citizenship status and date of birth.

[3] Sample excludes the unemployed and those still in education; part-time workers; the disabled; public employees; and all non-regular workers.

11 Appendix

11.a Bellman equations and wages

Compared to Wasmer (2006), equations involving specific investment remain unchanged. The only difference involves the equations involving general skills as the productivity of the worker will be specific to each individual and depend on his talent.

As a result, only equations concerning general investment are mentioned.

$$(r+\delta+\lambda)(W_i^g(\epsilon)-U_i^g)=w_i^g(\epsilon)-(r+\delta)U_i^g+\lambda\int \max[0,W_i^g(z)-U_i^g]dF(z) \tag{28}$$

$$(r+\delta+\lambda)(J_i^g(\epsilon)-V+T)=\epsilon+m_ih^g-w_i^g(\epsilon)-(r+\delta)(V-T)+\lambda\int Max[0,J_i^g(z)-V+T]dF(z) \tag{29}$$

$$(r+\delta+\lambda)(W_{0,i}^g-U_i^g)=w_{0,i}^g-(r+\delta)U_i^g+\lambda\int \max[0,W_i^g(z)-U_i^g]dF(z) \tag{30}$$

$$(r+\delta+\lambda)(J_{0,i}^g-V+T)=\epsilon_0+m_ih^g-w_{i,0}^g-(r+\delta)V-\lambda T+\lambda\int Max[0,J_i^g(z)-V+T]dF(z) \tag{31}$$

By adding the surplus of the worker and the surplus of the firm, one obtains the total surplus of the new born worker and of an older worker.

$$(r+\lambda+\delta)S_i^g(\epsilon)=\epsilon+m_ih^g-(r+\delta)(U_i^g+V-T)+\lambda\int Max[0,S_i(z)]dF(z) \tag{32}$$

$$(r+\lambda+\delta)S_{0,i}^g=\epsilon_0+m_ih^g-(r+\delta)(U_i^g+V)-\lambda T+\lambda\int Max[0,S_i(z)]dF(z) \tag{33}$$

By definition, R_i^g is the unique reservation productivity for each individual choosing investment in general skills. Formally, $S_i^g(R_i^g)=0$. Inserting R_i^g in the definition of $S_i^g(\epsilon)$, we obtain:

$$R_i^g=(r+\delta)(U_i^g+V-T)-m_ih^g-\lambda\int Max[0,S_i(z)]dF(z) \tag{34}$$

Which leads to the definition of $S_i^g(\epsilon_0)$:

$$S_i^g(\epsilon_0)=\frac{\epsilon_0-R_i^g}{r+\lambda+\delta} \tag{35}$$

And as a result, to $W^g_{0,i} = \beta\left(\frac{\epsilon_0 - R^g_i}{r+\lambda+\delta} - T\right) + U^g_i(m_i)$

It is then possible to obtain for each worker his initial wage and his subsequent wages after new productivity draws.

- The initial wage:

$$w^g_{0,i} = \beta[\epsilon_0 + m_i h^g - (r+\delta)(U^g_i + V) - \lambda T + \lambda \int Max[0, S_i(z)]dF(z)] + (r+\delta)U^g_i - \lambda \int Max[0, W^g_i(z) - U^g_i]dF(z) \quad (36)$$

$$w^g_{0,i} = (1-\beta)(r+\delta)U^g_i + \beta(\epsilon_0 + m_i h^g - (r+\delta)V - \lambda T) \quad (37)$$

- The subsequent wages:

$$w^g_i(\epsilon) = (1-\beta)(r+\delta)U^g_i + \beta[\epsilon + m_i h^g - (r+\delta)V + (r+\lambda)T] \quad (38)$$

11.b Skills and frictions

As Wasmer (2006), let us denote the functions extended out of the range by a tilde. These variables do not always coincide with worker i's optimal choice.General equilibrium results will be presented subsequently.

The steps are similar to Wasmer (2006) with a slight difference concerning the choice of general skills. We will however detail more the computation.

Step 1:

$$\Delta\tilde{W^i_0} = \tilde{W^g_{0,i}} - \tilde{W^s_0} = \beta\left(\frac{\epsilon_0 - \tilde{R}^g_i}{r+\delta+\lambda} - T\right) + U^g_i - \beta\left(\frac{\epsilon_0 - \tilde{R}^s}{r+\lambda+\delta} - T\right) - U^0 \quad (39)$$

Considering the definition of U^0 and U^g_i, one finds:

$$\Delta\tilde{W}_{0,i} = \Delta\tilde{U}_i - \beta\Delta\tilde{R}_i(r+\lambda+\delta)^{-1} \quad (40)$$

With $\Delta\tilde{U}_i = \frac{p}{r+\delta}\left(C - \frac{\beta\Delta\tilde{R}_i}{r+\lambda+\delta}\right)$.

Therefore, as usual, one can deduce that $\forall i$, $\Delta\tilde{W}_0 > 0$ implies that $pC - \beta\Delta\tilde{R}_i\frac{r+\delta+p}{r+\delta+\lambda} > 0$. For a more talented worker, this last equation will be more easily satisfied as $\Delta\tilde{R}_i$ is lower. In fact, it is quite intuitive: a more talented worker will tend to have a higher asset value for general skills compared to specific skills than a less talented worker.

Step 2: Lemma A1 (fragility of the match)

The intuition is also similar. The higher p and V are, the more frequent the separation between the worker and the firm is as job duration ($\frac{1}{\lambda F(\tilde{R^k})}$) is decreasing in p and V. When $p \to \infty$, $\Delta\tilde{R}_i \to 0$.

Proof:

Combining the definition of U^0 and U_i^g with the implicit definition of R^k, one finds:

$$\tilde{R}_i^g\left(1+\frac{p\beta}{r+\lambda+\delta}\right)+\frac{\lambda}{r+\lambda+\delta}\int_{\tilde{R}_i^g}^{\epsilon_0}(1-F(\epsilon'))d\epsilon' = b+p\beta\left(\frac{\epsilon_0}{r+\delta+\lambda}-T\right)+(r+\delta)(V-T)-m_ih^g \quad (41)$$

$$\tilde{R}^s\left(1+\frac{p\beta}{r+\lambda+\delta}\right)+\frac{\lambda}{r+\lambda+\delta}\int_{\tilde{R}^s}^{\epsilon_0}(1-F(\epsilon'))d\epsilon' = b+p\beta\left(\frac{\epsilon_0}{r+\delta+\lambda}-T\right)-pC^s+(r+\delta)(V-T)-h^s \quad (42)$$

Differentiating with respect to p and V:

$$d\tilde{R}_i^g\left(1-\lambda\frac{1-F(\tilde{R}_i^g)}{r+\lambda+\delta}+\frac{p\beta}{r+\lambda+\delta}\right)=\tilde{W}_{0,i}^g dp+(r+\delta)dV \quad (43)$$

$$d\tilde{R}^s\left(1-\lambda\frac{1-F(\tilde{R}^s)}{r+\lambda+\delta}+\frac{p\beta}{r+\lambda+\delta}\right)=(\tilde{W}_0^s-C^s)dp+(r+\delta)dV \quad (44)$$

To find $\tilde{W}_{0,i}^k - I_kC$ positive such that worker i prefers to invest in skills (general or specific), one needs ϵ_0 to be sufficiently large compared to C.

Moreover, it is then possible to derive the value of $\Delta\tilde{R}_i$ by subtracting ($\tilde{R}^s$) from ($\tilde{R}_i^g$)). Using Chasles's Relation:

$$\Delta\tilde{R}_i=\frac{\frac{\lambda}{r+\lambda+\delta}\int_{\tilde{R}^s}^{\tilde{R}_i^g}(1-F(\epsilon'))d\epsilon'-\Delta h_i}{1+\frac{p\beta}{r+\delta+\lambda}} \quad (45)$$

This equation confirms the intuition. An increase in talent tends to increase the job duration of a worker who had invested in general skills. Therefore, an increase in talent reduces the gap between the reservation productivity of general skills and specific skills. The extreme case is when the worker is so talented than $m_ih^g = h^s$ and $\tilde{R}_i^g = \tilde{R}^s$. For this worker, this equation confirms that $\Delta\tilde{R}_i = 0$ (which is indeed in itself a tautology!).

An other point concerns the effect of V and p on $\Delta\tilde{R}_i$. First, this equation states that when p tends to infinity, $\Delta\tilde{R}_i$ goes to 0. The intuition behind this is developed in Part 4. Partial Equilibrium. Secondly, one can also verify as in Wasmer (2006) than $\forall i$, the partial derivative of $\Delta\tilde{R}_i$ towards V is negative.

Step 3:

As in the usual framework, we now express $\Delta\tilde{W_0^i}$ as a function of p and V. Let us denote $\Lambda(V,p) = (r+\delta)\Delta\tilde{W}_{0,i}$.

We have:

$$\Lambda_i(V,p) = pC - \beta\Delta\tilde{R}_i(V,p)\frac{r+\delta+p}{r+\delta+\lambda} \tag{46}$$

Assuming as in the article that $\tilde{R}^s$ and $\tilde{R}_i^g$ are continuous and differentiable $\forall i$ with respect to p, $\Lambda(V,p)$ can also be considered continuous and differentiable.

Combining the value of $\Delta\tilde{R}_i$ in the equation of $\Lambda_i(V,p)$:

$$\Lambda_i(V,0) = \frac{-(r+\delta)\lambda}{(r+\delta+\lambda)^2}\left(\int_{\tilde{R}^s(V,0)}^{\tilde{R}_i^g(V,0)}(1-F(z))dz - \Delta h_i\right) \tag{47}$$

$$\Lambda_i(V,p) = pC - \beta\frac{r+\delta+p}{r+\delta+\lambda+\beta p}\frac{\lambda}{r+\lambda+\delta}\left(\int_{\tilde{R}^s}^{\tilde{R}_i^g}(1-F(z))dz - \Delta h_i\right) \tag{48}$$

One thus obtains $\forall i$, that $\Lambda_i(V,p)$ tends to infinity when p goes to infinity and that $\Lambda_i(V,0) \leq 0$. So for each individual there is a $p_i^M(V)$ such that $\Lambda_i(V,p) = 0$. For low values of p worker i prefers specific skills as long as $\Lambda_i(V,p) < 0$. Note that a very talented individual will prefer general skills even for low p as contrary to Wasmer (2006), $\Lambda_i(V,0) = 0$ for the most talented. For high values of p, worker i prefers general skills ($\Lambda_i(V,p) > 0$).

Step 4:

We then have to show the monotonicity of Λ_i in order to prove the uniqueness of p_i^M for each V.

As p_i^M is such that worker i is indifferent between specific and general skills, one finds from equation (44) with $\Lambda_i(V,p) = 0$:

$$\frac{\beta\Delta\tilde{R}_i}{r+\delta+\lambda} = \frac{p_i^M}{r+\delta+p_i^M}C \tag{49}$$

Around p_i^M, one finds for each worker, a similar equation to Wasmer (2006):

$$\frac{\partial\Lambda}{\partial p} = C\left(\frac{r+\delta}{r+\delta+p_i^M} - \frac{dln\Delta\tilde{R}_i}{dlnp}(p_i^M)\right) \tag{50}$$

Therefore, a sufficient condition to get a positive partial derivation is that $\Delta\tilde{R}_i$ does not vary with respect to p or that the elasticity is smaller than 1.

Step 5:

We have previously shown that for each worker, $\Delta\tilde{R}_i$ decreases with V. So as in the basic framework, $\Lambda_i(V,p)$ increases with V and thus $p_i^M(V)$ decreases with V.

Step 6:

Finally, a new-born worker will choose to invest in skills if $U^0 < \tilde{W}_i^s - C$ or if $U^0 < \tilde{W}^g - U^g - C + U^g$. Particularly, this first inequality will be more easily verified when:

$$\frac{\beta\epsilon_0 - \tilde{R}_i^g(p,V)}{r+\lambda+\delta} - T > C + U^0 - \tilde{U}^g \tag{51}$$

Intuitively, a more talented worker will be more likely to prefer to invest in general skills than make no investment as $\tilde{R}_i^g(p,V)$ will decrease.

11.c Unemployment

Let us denote e^k and u^k as the stock of jobs and unemployed workers possessing the various types of human capital (0, s, g). Then:

$$du^0/dt = \delta + e^s\lambda F(R^s) - (p+\delta)u^0 \tag{52}$$

$$de^s/dt = (1-\eta)u^0 p - (\delta + \lambda F(R^s))e^s + \alpha^s \eta u^0 p \tag{53}$$

$$du^g(\mu)/dt = e^g(\mu)\lambda F(R^g(\mu)) - (p+\delta)u^g(\mu) \tag{54}$$

$$de^g(\mu)/dt = u^g(\mu)p - [\delta + \lambda F(R^g(\mu))]e^g(\mu) + l(\mu)\eta u^0 p \tag{55}$$

where $\eta = \frac{\delta}{\delta+\lambda F(R^s)e^s}$ and represents the fraction of unemployed with no human capital who are newborn (have never worked before)

and $(1-\eta) = \frac{\lambda F(R^s)e^s}{\delta+\lambda F(R^s)e^s}$ represents the fraction of unemployed with no human capital who previously invested in s (and thus will do so again) but lost their jobs.

These quantities are derived from the inflow equation into u^0 where in equilibrium the relative proportion of newborn and fired s individuals in the stock of u^0 will equal the inflow proportions.

The intuition behind the flow equations is as follows:

Flows into unemployment with no human capital come from newborn workers and workers who invested in specific skills but were fired following an unfavorable productivity shock. Outflows represent such unemployed who either find a job or die.

Flows into jobs where workers invest in specific human capital come from previously unemployed workers with no human capital - those who are newborn and who find a job and choose specific skills in their first job and those who already held an job before, invested in specific skills previously, and now repeat this choice upon finding a new job. Outflows represent currently employed workers with specific skills who either experience an unfavorable productivity shock and are thus fired or those who die.

Unemployment of workers who invest in general skills becomes somewhat more complex as they face different expected job durations depending on their level of talent. This will lead to different unemployment rates depending on talent as the job finding and death rates are the same for all agents (outflows from unemployment) but the rate of being fired will be smaller for more talented workers as they can tolerate a wider range of random productivity shocks (inflows into unemployment). It is easier to think of the problem if one imagines talent as a discrete variable with a finite range of values. Then a separate unemployment rate can be established for each talent level above the talent threshold m_l (where individuals choose general skills). The overall unemployment rate for workers who invest in general skills will then be the sum of the unemployment rates defined per level of talent, much like the overall unemployment rate of the economy was the sum of the unemployment rates for s and g workers in the mixed regime in Wasmer (2006).

The stocks of unemployment in a steady state become:

$$u^0 = \frac{\delta}{\delta + p}\left(1 - \frac{\lambda F(R^s)p(1-\eta+\alpha^s\eta)}{[\delta+\lambda F(R^s)](p+\delta)}\right)^{-1} \tag{56}$$

$$u^g(\mu) = \frac{\lambda F(R^g(\mu))l(\mu)\eta p u^0}{[\delta+\lambda F(R^g(\mu))][p+\delta-\frac{p\lambda F(R^g(\mu))}{\delta+\lambda F(R^g(\mu))}]} \tag{57}$$

$$u^g = \int_{m_l}^{\frac{h^s}{h^g}} u^g(\mu)d\mu \tag{58}$$

The overall unemployment rate u is just the sum of these two stocks.

Finally, κ^g and κ^s, the fraction of unemployed who will pick general and specific skills respectively can be expressed as:

$$\kappa^g = \frac{u^g + \alpha^g\eta u^0}{u} \tag{59}$$

$$\kappa^s = \frac{\alpha^s\eta u^0 + (1-\eta)u^0}{u} \tag{60}$$

They will not necessarily be equal to α^g and α^s, the overall population proportions of workers who choose general and specific skills respectively. The latter is determined by the talent distribution and notably the talent cutoff for investing in specific or general human capital. Indeed, newborn workers will choose to invest in general and specific skills in these proportions, on average. However, so long as the outflows from employment of the different type of workers choosing g are not equal, the overall mix of unemployed choosing g will be altered from the overall population proportion. [10]

[10] Please note that $\kappa^s = \alpha^s$ if $\eta = 1$ and $u^0 = u$. This case will indeed capture an economy where all unemployed with no human capital are new-born workers.