Social Insurance and Efficient Occupational Mobility

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Abstract

By experimenting in the labor market, workers find their best occupational fit in a process filled with uncertainty. If workers are risk averse and there is limited earnings insurance, workers may remain in unfitting occupations when better matches are available. We propose a a dynamic assignment model with incomplete markets to illustrate how social insurance policies encourage experimentation, leading to a better matching of workers to occupations. We estimate the model using micro-data from the United States and Germany. Higher earnings uncertainty explains the United States higher mobility rate. Allowing workers in the United States to enjoy Germany's degree of social insurance leads to even more mobility and experimentation. Output and welfare gains are large.

Key words: Comparative Advantage, Social Insurance, Occupational Choice
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1 Introduction

This is a quantitative study of the effect of social insurance policies on workers' occupational choice and mobility. Workers are heterogeneous in their abilities to work in different occupations and they learn their comparative advantage by experimenting. This process helps them find their best occupational fit. However, experimentation is risky. Workers' comparative advantage is only revealed by sequentially trying occupations and often little is known about prospective occupations. But having settled in an occupation, workers also face earnings risk. Adverse earnings shocks lead workers to try to find a better match. The interaction between workers' abilities and earnings risk determines their career choice. When workers are risk averse and opportunities to insure earnings risk are limited, social insurance distorts the price of risk and therefore the allocation of workers across occupations. This way, social insurance policies partially substitute missing private insurance markets, providing incentives to take more risk and experimenting more. As a consequence, social insurance improves the sorting of workers into occupations, raising output and welfare.

One of the central questions in macroeconomics and public finance is how to design taxation schemes and social insurance policies. We contribute to this area by studying the interaction of social insurance policies and occupational mobility. Specifically, we pose and answer the following questions: Do occupations differ in the level of idiosyncratic labor income risk? If so, how do workers' comparative advantages and idiosyncratic risk affect their career choice and mobility? How do social insurance policies affect the sorting of individuals across occupations as well as their occupational mobility? Is this effect quantitatively important? What are the implications for output and welfare? By answering these questions we make theoretical and quantitative contributions. On the theoretical side we build an ability-to-occupation assignment model (a.k.a Roy (1951) model) with missing insurance markets. By doing so we provide a theory of occupational mobility that allows us to analyze the effect of labor income risk and social insurance policies on workers' occupational choice. On the quantitative side, we document new facts for the United States and Germany. With our model and data from those two countries, we derive the implications of changing a widely used policy: progressive taxation. We abstract from the negative effect of progressivity on labor supply and savings, to focus instead on its positive role as an insurance provider. The higher the degree of progressivity, the higher the degree of insurance. This encourages risk-taking, leading to a better sorting of workers into occupations, and raising output as a result. Although an allocation that raises output is not necessarily welfare improving, welfare rises in our case due to both a higher output level - because of the better sorting - and the lower volatility of consumption.

We begin our study by documenting new facts regarding earnings risk and occupational mobility for the United States and Germany. We focus our analysis on these two countries due to the substantial differences on the tax systems previously documented in the literature, (see Guvenen and Ozkan (2014) and Holter, Krueger, and Stepanchuk (2014)). The German tax system is more progressive than that of the United States. In addition, we also have comparable longitudinal micro data available.

There are three additional novel aspects of the data that further motivate our study. First, the US labor market is much riskier than the German labor market. We estimate the variance of permanent shocks to labor earnings in both countries and find that earnings in the US are much more volatile than in Germany. Differences in earnings risk affect workers' occupational choice and the effect of changing social insurance policies.

Second, in both countries there is substantial variation in the level of risk across occupations. In the US, sales workers are the ones that experience large permanent shocks to earnings, while administrative workers are insulated from permanent earnings variability. In Germany, the riskiest occupation is being a manager and the safest is being a clerical worker. Although, there are substantial differences across these two countries in the magnitudes, there are occupations that are relatively risky or safe in both countries. For instance, being an athlete or an artist is risky in both the US and Germany. On the other hand, manufacturing is relatively safe in both countries.

Third, occupational mobility - the rate at which workers change occupations - is substantially lower in Germany. The US workers experience more risk and thus it is not surprising that we observe more mobility relative to German workers. The fact US workers face more risk makes them to change occupations more often as it is more likely to receive a negative earning shock that pushes them to try another occupation. In addition, a riskier labor market also offer opportunities and thus will also determine more mobility.

Although we observe more mobility in the US at all ages, once we take into account the cross-country differences in the magnitude of the shocks workers face, the propensity of a German worker to switch an occupation is similar to the estimated for a US workers. German workers have more insurance which, everything else equal, allows them to take more risk in the labor market. In order to quantitatively assess the importance of these forces we propose a quantitatively model which is then calibrated to US and German data.

We construct a life-cycle model where individuals are risk averse and finance consumption by providing labor services. Earnings are risky and no insurance exists to hedge against that risk. Every period individuals decide the occupation in which to supply their labor. Workers are heterogeneous in their abilities to work in different occupations. However, knowledge of those abilities only gets revealed as workers try occupations. Occupations differ in their degree of earnings variability. Once workers settle in an occupation, they face occupation-specific idiosyncratic earnings risk. Since these earnings shocks are permanent, they are also a source of occupational mobility: facing a negative shock, they can decide to switch to an alternative occupation. This switch entails uncertainty, but it can offer workers an opportunity to find a better match. Therefore, there is a clear trade-off between experimentation and exploitation.

We restrict our policy analysis to changes in progressive taxation. In other words, the model economy features a government who taxes earnings with a more or less progressive tax function. In particular, we follow the literature on macroeconomics and restrict the income tax code to a particular class of parametric functions, first proposed by Berliant and Gouveia (1993). [1] Although, one can consider a richer structure for a social insurance policy, this approach is appealing since: i) it is tractable, ii) it approximates closely and parsimoniously the income tax codes and iii) the functional forms are flexible enough to incorporate a wide variety of transfer schemes. What is important for us is that the degree of progressivity determines the insurance provided by the government which influences the amount of risk workers are willing to bear. This way, more insurance implies more experimentation by workers.

We calibrate the model to the United States and Germany. For that purpose, we use our estimates of permanent earning risk as well as data on occupational mobility. In addition, we use earnings data of young workers to discipline the distribution of occupation-specific abilities. We incorporate the differences in the degree of social insurance by using the estimated tax functions for these two countries provided in Holter, Krueger, and Stepanchuk (2014).

We perform three counterfactual experiments. We first analyze the effect of changes in the level of social insurance provided by the income tax schemes. We give each benchmark economy the tax function of the other. In this way, US workers experience their own estimated earnings shocks but they obtain more insurance through the more progressive tax system of Germany. As a result, occupation mobility increases as workers are willing to take more risk. The higher mobility yields a better assignment of workers to occupations. That better assignment leads to an increase in output (3.7%) and pre-tax earnings inequality. More importantly, the extra insurance provided by the higher progressivity of the tax system increases welfare by 6.5% of annual consumption. In order to investigate the welfare effects of such a policy change

[1] Other examples using this type of tax functions are Conesa and Krueger (2006), Guvenen and Ozkan (2014), Heathcote, Storesletten, and Violante (2014), Ventura (1997), and Holter, Krueger, and Stepanchuk (2014).

we compute the consumption equivalent variation (CEV). When US workers enjoy the insurance of Germany there are substantial welfare gains, specifically 2.55%. In this counterfactual economy, US workers not only enjoy better consumption smoothing opportunities but also higher levels of consumption providing output increases due to the better sorting of workers into occupations. In the same way, we perform the counterfactual exercise in which we give Germany the less progressive tax system of the US. Contrary to the previous case and, as expected, occupational mobility goes down as well as output. Pre-tax earnings inequality falls as well. We also compute CEV for this case and find that there are substantial welfare losses.

In our second counterfactual experiment we give to each of the benchmark economies the other economy's estimated shocks. For instance, we make the German workers to live in the risky US labor market. Relative to the benchmark case, the probability of a worker to stay in an occupation is lower and at the same time this economy offers them better opportunities. As a result occupational mobility substantially increases: the mobility rate increases almost 10 percentage points. The large increase in mobility results in a better sorting of workers and thus in a substantially higher level of output which increases by 23%. Due to the better sorting inequality also increases. However, these workers now experience substantial welfare losses due to the dramatic increase in the volatility of earnings relative to the benchmark. Contrary to the previous case when US workers face the much lower permanent shocks of Germany, mobility rates drop by almost 14 percentage points lower than in the baseline economy. Because the high productivity workers are much less productive - the right tail is much shorter now, aggregate output falls by close to 40%. Earnings inequality falls almost in the same proportion as well since there is less experimentation due to the fact workers have less risk taking opportunities and as a result, the equilibrium earnings distribution shrinks. These experiments confirms that the magnitude of the permanent shocks explain the bulk of the cross-country differences in the observed occupational mobility.

In our last counterfactual experiment we make all workers in each of the economy to be ex-ante homogeneous. That means, workers do not have a comparative advantage to work in a occupation and all the experimentation occurs through the shocks to their general human capital. In both countries, occupational mobility raises. Without occupation-specific abilities workers have worse matches to occupations and thus they are less attached to them. As a result, for the same shocks they move more than in the baseline case. This worse sorting lowers productivity, and output as a result. Output is 13% lower in the case of the US and 8.5% lower in the case of Germany. Although occupational mobility is higher, the fact that workers are much more similar compared to the baseline case (ex-ante homogeneous) implies pre-tax earnings volatility also falls in both countries. Interestingly, these experiments allows us to explore the sources of earnings inequality. In both countries the most the lifetime inequality is explained by the shocks to the general human capital that occur during their labor career (80% in the US and 70% in Germany), the rest is due to their differences in occupation-specific abilities (ex-ante heterogeneity).

Related Literature: Occupational mobility was previously studied and its importance for macroeconomic aggregates is very well documented in the literature (see for instance Kambourov and Manovskii (2009) and Kambourov and Manovskii (2008) for the case of US). Experimentation in the labor market has also been studied and we incorporate the mechanisms present in Jovanovic (1979) and Miller (1984). More recently, Papageorgiou (2014) provides evidence on the process of the discovery of workers' occupation-abilities in the labor market. With a framework different from ours this study highlights the importance of the process of discovering occupation-specific abilities in driving occupational mobility in the US. Our case, we both complement empirical findings by providing evidence for Germany and its comparison with the US but, more importantly, by linking occupational mobility to the occupation-specific risk faced by workers. Our paper is also related to Cubas and Silos (2017) and Neumuller (2014) but the framework presented here is much richer as it incorporates in a tractable way the interaction between comparative advantages and risk. This interplay determines occupational mobility and the sorting of workers in the labor market. This framework allows us to obtain welfare implications of insurance opportunities.

Much work has been devoted to constructing economic environments where income taxation affects the labor supply of individuals both at the extensive and intensive margin (see Rogerson (2006), Prescott (2004), Guner and Ventura (2012), among others). Inspired by the work of Mirrlees (1974), there is a strand of the literature that has focused on the effect of social insurance in the labor supply of agents. In particular, Conesa and Krueger (2006) and Conesa, Kitao, and Krueger (2009) study the effect of the insurance derived from progressive taxation schemes in general equilibrium models with incomplete markets. Acemoglu and Shimer (1999) and Acemoglu and Shimer (2000) study the positive effect of unemployment insurance policies on the sorting of workers into jobs. Another example is Golosov, Kocherlakota, and Tsyvinski (2003) who also incorporate idiosyncratic income shocks and private information to study the optimality of capital taxation. Also, Stantcheva (2015) and Stantcheva (2017) study optimal taxation schemes when human capital investments are risky and workers abilities are private information. We abstract from the effects of idiosyncratic shocks on the intensive margin of labor supply as well as informational frictions but we provide a new framework and channel through which progressive taxation affects the occupational choice of workers.

In addition, there is a recent related literature that uses task-to-talent assignment models similar to the ones developed in Autor and Dorn (2013) and Acemoglu and Autor (2011) to analyze optimal taxation problems. Examples are Rothschild and Scheuer (2013) and Ales, Kurnaz, and Sleet (2015) who study optimal taxation in static models when the talent of individuals is private information. The work of Lockwood and Weyl (2017) also contributes to this strand of the literature. However, there are very important questions in public economics and macroeconomics that inherently dynamics. Workers's skills change stochastically and have a life cycle component, thus the analysis of social insurance policy requires the use of a dynamic framework. Moreover, in our case is even more important as the uncertainty from idiosyncratic shocks not only affects productivity in the traditional way but also affects the sorting of workers. Our focus is not on the normative part and we take a more quantitative approach to focus on how the interplay between uninsurable labor income risk and social insurance affects the career choice of individuals. More importantly, as already discussed the career choice is partially determined by the discovery of workers comparative advantage through experimentation. Therefore, we bring together these different strands of the literature by incorporating an assignment model into an incomplete market quantitative framework that highlights a mechanism that affects the majority of the workers in the labor force.

2 Facts

Our goal is to analyze the role of earnings shocks and the effect of insurance opportunities on the occupational choice of individuals. We begin by documenting new facts on occupational earnings risk and mobility for Germany and the United States. The reason we focus on these two economies is twofold. First, they are the two largest economies for which we have high-quality harmonized panel data on earnings and occupations, for roughly the same time period. Second, despite being two advanced economies possibly at the technological frontier, their social insurance policies differ to a large degree and thus they constitute a good input to perform our policy experiments.

2.1 Labor Income Shocks

This section documents substantial differences in the variance of permanent shocks to earnings faced by workers in these two countries. After describing our data sources, we briefly outline our methodology for estimating the variance of the permanent component of earnings risk. We end by examining how that variance differs by country and occupation.

2.1.1 Data

We use comparable cross-country longitudinal household surveys provided by the Cross-National Equivalent File (CNEF) at Ohio State University. The file contains consistently defined variables for a set of developed countries. Included in that data set are the US Panel Study of Income Dynamics (PSID) and the German Socio-Economic Panel (SOEP).

The Panel Study of Income Dynamics (PSID) The PSID started in 1968 collecting information on a sample of roughly 5,000 households. Of these, about 3,000 were representative of the US population as a whole (the core sample), and about 2,000 were low-income families (the Census Bureau's SEO sample). Thereafter, both the original families and their split-offs (children of the original family forming a family of their own) have been followed. The panel is annual until 1997. It has since become biennial. In the empirical analysis we employ the entire sample from 1980 through 2007 and we adapt the estimation methodology to the change in the sampling frequency [2].

The Socio-Economic Panel (SOEP) The SOEP data are drawn from the SOEP-CNEF files. The German Socio-Economic Panel (SOEP) is a wide-ranging representative longitudinal study of private households, located at the German Institute for Economic

[2] Although the PSID starts in 1968, we employ the data from 1980 since it has problems regarding the occupation classification as it is documented in Kambourov and Manovskii (2013)

Research, DIW Berlin. Every year, there are nearly 15,000 households, and about 25,000 persons, sampled. The data provide information on all household members, consisting of Germans living in the Old and New German States, Foreigners, and recent Immigrants to Germany. The Panel started in 1984 and we employ data up to 2012.

For both countries, we restrict our sample to working-age individuals, aged 22-66. We drop those that are not employed or that are self-employed, those who do not report earnings, education or hours worked, as well as individuals with less than 8 years of consecutive data. In the PSID-CNEF, individuals are classified into occupations according to ISCO-68 and industries according to a 34 industry classification provided by the CNEF [3]. In the SOEP the occupations are provided by using the ISCO-2008 (an update of ISCO-68) classification so we convert them to the ISCO-68 by following the cross-walk provided by the ILO. After grouping the data into 12 occupations, the resulting data set is panel of individuals labor earnings per hour, employment status, age, education level, industry, occupation and gender.

2.1.2 Econometric Model

We use a regression approach extensively used int the literature (see for instance Carroll and Samwick (1997)) to compute earnings variability at the individual level. We estimate a fixed effects model for each occupation j in our sample. Given a panel of N individuals for whom we measure earnings (and other variables) over a period of time T, we assume that (log) earnings for individual i in occupation j at time t, y_{ijt} can written as

$$y_{ijt} = \alpha_{ij} + \boldsymbol{\beta}_j \boldsymbol{X}_{ijt} + u_{ijt} \tag{1}$$

The vector $\boldsymbol{X}$ includes observables that predict changes in the level of log earnings.

[3] ISCO-68 refers to the first International Standard Classification of Occupations issued by the International Labor Organization (ILO).

It includes age, sex, ethnicity, years of schooling, an industry dummy, and time dummies. We estimate equation ((9)) for all individuals in a given occupation. Repeating this procedure for all occupations yields estimates $\{\hat{\alpha}_{ij}, \hat{\boldsymbol{\beta}}_j\}_{j=1}^{12}$.

Given a degree of individual's risk aversion, small differences in either the magnitude and the persistence of the shocks across occupations may imply large differences in welfare. To account for this difference in the nature of risk, we enrich our empirical analysis by allowing the error term to be decomposed into a permanent component and a transitory component. Transitory shocks (e.g., the loss of an important customer for a consultant) can be easily weathered by using small levels of savings. Permanent shocks last longer and can be associated with, for instance, depreciation of job-specific human capital or permanent changes in how an industry operates. Smoothing out the latter type of shock through a buffer stock of savings is more difficult and permanent changes in consumption are often required. Our analysis focuses on permanent shocks.

We follow Carroll and Samwick (1997) and Low, Meghir, and Pistaferri (2010), among others, by assuming that

$$u_{ijt} = \eta_{ijt} + \omega_{ijt}, \tag{2}$$

where η_{ijt}, the transitory component, is distributed i.i.d. $N(0, \sigma^2_{j,\eta})$, and ω_{ijt}, the permanent component, is a random walk, that is,

$$\omega_{ijt} = \omega_{ij,t-1} + \epsilon_{ijt} \tag{3}$$

with i.i.d. innovations ϵ_{ijt} that are distributed $N(0, \sigma^2_{j,\epsilon})$. By estimating equation ((9)), we obtain $\{\{\hat{u}_{ijt}\}_{i=1}^{N_j}\}_{t=1}^{T}$.

We estimate the variances of the permanent and transitory components by following the identification procedure similar to the one proposed by Low, Meghir, and Pistaferri (2010). Given that the PSID is biannual after 1997 we take second differences in equation ((9)) and given the process specified in ((2)), we have

$$\Delta_2 y_{ijt} = y_{ijt} - y_{ijt-2} = \boldsymbol{\beta}_j \boldsymbol{X}_{ijt} + \eta_{ijt} + \omega_{ijt} - \boldsymbol{\beta}_j \boldsymbol{X}_{ijt-2} + \eta_{ijt-2} + \omega_{ijt-2}. \tag{4}$$

Now define

$$g_{ijt} = \Delta(y_{ijt} - \boldsymbol{\beta}_j \boldsymbol{X}_{ijt}) = \Delta\eta_{ijt} + \epsilon_{ijt}, \tag{5}$$

and

$$g_{2ijt} = \Delta_2(y_{ijt} - \boldsymbol{\beta}_j \boldsymbol{X}_{ijt}) = \eta_{ijt} + \omega_{ijt} - \eta_{ijt-2} - \omega_{ijt-2} = \eta_{ijt} - \eta_{ijt-2} + \epsilon_{ijt} + \epsilon_{ijt-1}. \tag{6}$$

To identify the parameters of interest, we compute

$$E(g_{2ijt} g_{2ijt}) = 2\sigma^2_{\epsilon_{ij}} + 2\sigma^2_{\eta_{ij}} \tag{7}$$

and

$$E(g_{ijt} g_{ijt-1}) = -\sigma^2_{\eta_{ij}}. \tag{8}$$

To estimate the variances of the two innovations, we proceed as follows. For a sample of workers in a given occupation j, we estimate $\widehat{E(g^2_{ijt} g^2_{ijt})}$ and $\widehat{E(g_{ijt} g_{ijt-1})}$ using the sample analogs. Solving the system comprised of the previous two equations, we obtain $\widehat{\sigma^2_{\epsilon_j}}$ and $\widehat{\sigma^2_{\eta_j}}$.

2.1.3 Results

Table 1 shows the estimated variance of the permanent shocks to labor earnings by occupation and country. There are substantial differences in earnings uncertainty across occupations. For instance, US sales workers face higher permanent risk than Teachers. Risk also differs across the two countries; generally the US is riskier than Germany. However, certain occupations are safer in the US than in Germany and vice-versa. For example, Managerial workers face less risk in the US while the opposite is true for Manufacturing workers. Although, in our quantitative analysis we take these differences as exogenous, they may reflect differences in the labor markets of these countries and they will have non/trivial consequences in the workers careers choice as well as they consumption and saving behavior. What is important for us is that given the lack of insurance opportunities this heterogeneity in the variances of shocks across occupations makes workers to move across occupations to take advantage of the option they present for them.

2.2 Tax Progressivity

Another important dimension these countries differ is in the degree of progressivity of their tax schedule. Figure 1 show the tax functions estimated for these two countries. Germany is much more progressive than the US. As progressivity provides insurance then it could also explains the differences in mobility patterns observed in the data and thus affects the sorting of workers into occupations. As a result, it potentially has interesting welfare implications: the more progressive the tax system the more sorting we would observe in the labor market and thus it could serve as a way to complete the market increasing output and welfare.

2.3 Risk and Occupational Mobility

As it is commented above the differences in the variance of shocks across occupations may be important to explain occupational mobility not only within a country for different workers' age but also across countries providing these countries greatly differ in terms of the overall level of risk.

Indeed, occupational mobility in the US is much larger than in Germany. Due to restrictions in the frequency of the US data, we compute two year mobility rates for both countries. Defining occupational mobility rates as the proportion of workers that change occupations between two consecutive periods (being the period two years and conditional on being present in the data in both periods), we find that on average

19.2% of US workers change occupations. However, in Germany only 2.8% change occupations.

Although, it is clear that mobility is higher in the US, the reason could the fact that US is much more volatile than Germany. In order to explore the role of the shocks workers receive on occupational mobility, we propose a Logit model.

We first estimate the following pooled wage regression:

$$y_{it} = \alpha + \boldsymbol{\eta} \boldsymbol{H}_{it} + \nu_{it} \tag{9}$$

The vector $\boldsymbol{H}$ includes several variables that help predict changes in the level of log earnings. Specifically, we include age, sex, ethnicity, education, occupation, industry, and time dummies. We estimate this regression for each country to obtain $\hat{\nu}$. These estimated residuals represent the realized shocks to earnings that individuals experience. Then we postulate the following econometric model:

$$P_{i,t} \equiv Pr(y_{i,t} = 1 \mid \hat{\nu}^{-}_{i,t}) = E(y_{i,t} \mid \hat{\nu}^{-}_{i,t}) = \psi(\hat{\nu}^{-}_{i,t}; \beta) \tag{10}$$

In this specification, P_i is the probability that individual i switches the occupation and ψ is the Logit function. The variable p_i is a binary variable that takes the value one if the worker i switches the occupation between period t and $t+1$. The variable $\hat{\nu}^{-}$ are the negative values of $\hat{\nu}$ from the previous regression. [4] We are interested in analyzing the effect of the magnitudes of the negative shocks to earnings on the probability of occupational switches, thus, the coefficient associated with $\hat{\nu}$ which represents the switching decisions of workers when facing a negative shock. It does not mean that positive shocks are not important, actually, according to Manovskii and Kircher (2016), large positive realizations of earnings shocks imply occupational changes associated with career progression. However, our focus is on occupational changes associated with negative shocks and the model we present below will incor-

[4] If there is an occupational switch in the data that does not correspond to a negative realization of the shock, then $\hat{\nu}^{-}$ takes the value zero in this regression.

porate them. Nevertheless, in the Appendix we provide estimates of a set of different specifications for this regression. For instance, we include other control variables and as already mentioned as well as the positive values of $\hat{\upsilon}$.

For the estimation of these two econometric models we have selected the samples for both countries to include data until 1997. [5] Table 2 present the results of the estimation for both countries. The value of the coefficient estimated for Germany is -0.043 and for the US is -0.03. That means, in both countries the more negative the shock the workers face the higher the probability they switch the occupation. Interestingly, this effect is similar in magnitude between these two countries. Actually, in this specification the coefficient of Germany is slightly larger in absolute value. What is important is that although mobility rates are substantially higher in the US, once we take into account the differences magnitude of the shocks that workers face between the two countries, the probability of a worker to switch the occupation is quite similar, if not slightly higher in Germany. There are many reasons behind observed occupational changes and although our focus is only on the role of earnings shocks, they prove to be very important in explaining cross-country differences in occupational mobility. As already discussed, German workers enjoy more insurance coming from their more progressive tax schedule and thus they would switch occupations more often than US workers when facing socks of the same magnitude. In order to quantify the magnitudes of these effect we propose a model which is described in the next section.

3 Quantitative Model

3.1 Households

The economy is populated by a continuum of workers who value the consumption of a final good. Every period they are endowed with a unit of time. They live for S periods, financing consumption using labor earnings. Workers rank levels of con-

[5]The PSID become biannual starting in this year.

sumption c of the final good according to a utility function $u(c)$. This function is concave and as a result, workers dislike risk. Finally, workers do not value leisure supplying all of their time in a labor market described in detail below.

3.2 The Labor Market

The labor market features different occupations. There are J occupations available labeled with an index j from 1 to J. Occupations are mutually exclusive; workers can only work in one occupation during any given period. However, they may switch occupations between periods. During their tenure in occupation j, workers receive a wage w_j per unit of human capital they possess. Human capital comes in two varieties. The first variety is an occupation-specific ability. Every worker is born with a vector of $\{\theta_j\}_{j=1}^J$. The elements of this vector are discovered sequentially, as workers experiment and sample different occupations. For a given occupation j, the value of θ_j is unknown to the worker until the first time occupation j is tried. Once discovered, that specific θ remains with the worker until his death. In what follows, it will be convenient to define the set $J(s)$ as the set of occupations tried by (the beginning of) age s and the set $\{\tilde{\theta}\}_{j\in J(s)}$ as the set of abilities for those occupations already tried.

The second type of human capital is general and therefore transferable across occupations. The stock of this type of human capital, denoted by z, evolves over a worker's career. Despite its generality, the evolution of this type of human capital depends on the worker's current occupation. To be more specific, while working in a given occupation, z changes randomly, and the shocks that affect it are occupation-specific. Shocks to z are an additional source of occupational mobility and they are denoted by ϵ. Formally, while an individual works in occupation j, his general human capital evolves according to $z' = z + \epsilon_j$, and $\epsilon_j \sim N(0, \sigma_j^2)$. We are agnostic about the exact nature of these shocks. They capture, for example, the interaction between a worker's skills and an occupation's response to technological innovation. In other words, occupations react differently to changes in technology, and given that reaction, a worker's human capital may suffer more or less depending on his portfolio of skills. At any rate, as the evidence we provide shows, occupation-specific shocks to earnings are a feature of the data.

3.3 Technology

There is a set of J intermediate service producers indexed by j that we associate with occupations. The quantity of intermediate service j each produces is X_j using a linear technology in labor N_j; that is, $X_j = N_j$. The producer faces prices for her service p_j and wages w_j. Both product and labor markets are competitive.

The producer of intermediate service j solves the following maximization problem:

$$\max_{N_j} p_j X_j - N_j w_j \tag{11}$$

subject to $X_j = N_j$. Intermediate service producers sell to a final goods producer. To produce Y units of the final good, a technology aggregates intermediate services $\{X_1, \ldots, X_J\}$ is described by, [6]

$$Y = \prod_{j=1}^{J} \left\{ X_j^{\alpha_j} \right\}. \tag{12}$$

The final good producer faces purchase prices $\{p_j\}_{j=1}^{J}$ for the different occupations. The final good is the numeraire and its price is one. Formally, its producer solves,

$$\max_{\{X_1,\ldots,X_J\}} \prod_{j=1}^{J} \left\{ X_j^{\alpha_j} \right\} - p_j X_j. \tag{13}$$

Note that in equilibrium $X_j = N_j$ and $p_j = w_j$, so the solution to this maximization problem implicitly defines labor demand functions $\left\{ N_j = N_j^d(w_j, N_{-j}) \right\}_{j=1}^{J}$

[6] We assume no capital in this version but it is an easy-to-add feature.

3.4 Worker Optimization

Workers choose a sequence of occupations to maximize life-time utility. In any period s, a worker's remaining lifetime utility is summarized by a function $W_s(z, \epsilon_j, j)$. Its arguments are the current level of productivity z, and a shock ϵ that shifts the worker's productivity in current occupation j.

At the beginning of the period the worker faces an occupational choice decision. She can remain in her current occupation, with total productivity equal to $z + \epsilon_j$ and known ability θ_j, or she can try an alternative occupation. Some alternatives have never been tried before and for those the ability θ is unknown. Define by $W_s(\Omega_s, z, \epsilon, j)$ the maximum value an age-s agent obtains by choosing among J mutually exclusive occupations. This choice depends on the set of occupations the worker has visited before $J(s-1)$, as well as their associated abilities $\{\theta_j\}_{j \in J(s-1)}$. These two elements make up Ω_s. The choice also depends on the current stock of general human capital z, its current innovation ϵ, and the current occupation j.

The following expression formally describes the choice between a known occupation j and a set of alternative occupations j'.

$$W_s(\Omega_s, z, \epsilon, j) = \max \left\{ V_s(\Omega_s, z, \epsilon, j), \{V_s(\Omega_s, z, j')\}_{j' \neq j} \right\}.$$

The value of remaining in the current occupation j, $V_s(\Omega_s, z, \epsilon, j)$, is conditional on a particular value of the random variable ϵ (the shock to general human capital z). Alternative occupations - those labeled j' - never depend on $\epsilon_{j'}$, and only depend on $\theta_{j'}$ if it is already known; that is, if the worker has worked in j' at some point in his past.

The value of staying is given by the maximum value attained by working in occupation j:

$$V_s(\Omega_s, z, \epsilon, j) = \left\{ u(c) + \beta \int W_{s+1}(\Omega_{s+1}, z', \epsilon', j) dF_j(\epsilon) \right\}, s.to$$

$$c = T\left(w_j e^{\theta_j} e^{z} e^{\epsilon}\right) \tag{14}$$

$$z' = z + \epsilon \tag{15}$$

$$\Omega_{s+1} = \Omega_s \tag{16}$$

The continuation value is the maximum among J occupations knowing that productivity in occupation j will experience a shock ϵ'. The flow budget constraint (14) equates consumption to total income, which equals after-tax earnings $T(w_j e^{\theta_j} e^{z} e^{\epsilon})$. Pre-tax earnings are equal to the product of a wage rate w_j and amount of efficiency units $e^{z} e^{\theta_j} e^{\epsilon}$. A progressive tax function $T(\cdot)$ applied to pre-tax earnings gives the after-tax amount available to finance expenditures.

The (log of) general human capital z evolves according to (15). The current shock ϵ is added to the stock z to update it to its new value z'. Finally, remaining in the same occupation adds no new information to Ω_s, and as a result $\Omega_{s+1} = \Omega_s$.

By switching occupations a worker bets that his performance will improve as a result of the change. If the occupation is tried for the first time, the outcome is uncertain because both ϵ and θ in the new occupation are unknown. The worker takes expectations with respect to both distributions to compute the value of the alternative occupation. If at some point the worker has tried occupation j', uncertainty involves only ϵ.

Recall that Ω includes the set $J(s-1)$, the set of known occupations. If j' is not an element of $J(s-1)$, the value of the alternative occupation is,

$$V_s\left(\Omega_s, z, j'\right) = \int V_s\left(\Omega_s, \theta, z, \epsilon, j'\right) dG_{j'}(\theta) dF_{j'}(\epsilon), \tag{17}$$

Conditional on a particular θ and ϵ, the value of the alternative occupation is the maximum attained by adding the utility flow from earnings plust the continuation value.

$$V_s(\Omega_s, \theta_{j'}, z, \epsilon, j') = \left\{ u(c) + \beta \int W_{s+1}(\Omega_{s+1}, z', \epsilon', j') dF_{j'}(\epsilon') \right\}, s.to \tag{18}$$

$$c = T\left(w_{j'} e^z e^{\theta_{j'}} e^{\epsilon_{j'}} e^{-c(s,\boldsymbol{\kappa})}\right) \tag{19}$$

$$z' = z + \epsilon'_j \tag{20}$$

$$\Omega_{s+1} = \left\{\Omega_s, j', \theta_{j'}\right\} \tag{21}$$

This maximization problem is similar to the one when a worker remains in the same occupation. There are two differences. First, as is clear from (21), the set Ω_s grows, because the worker gets new information about his ability in the new occupation j. The second difference is the term $e^{-c(s,\boldsymbol{\kappa})}$, affecting the amount of efficiency units and reflecting a (temporary) human capital loss. This cost is borne by all switchers, regardless of whether the new occupation has been tried before. The function $c(s, \boldsymbol{\kappa})$ is a mobility cost function that depends on age and on a vector of parameters $\boldsymbol{\kappa}$. This specification permits modeling in a flexible way the mobility costs facing workers as they age.

The problem of evaluating an occupation j' that has been visited before is simpler. The only uncertainty facing the worker is with respect to the shock ϵ in j'. The alternative value for this case - the analog to equation (17) - can be written as

$$V_s\left(\Omega_s, z, j'\right) = \int V_s\left(\Omega_s, z, \epsilon, j'\right) dF_{j'}(\epsilon). \tag{22}$$

Note that the ability parameter $\theta_{j'}$ is an element of Ω_s, because the worker has previously visited that occupation. The description of the optimization problem is almost identical to (18)-(21). An exception is equation (21) which now becomes (16). In words, no new information is revealed about workers' innate abilities.

The previous description of the occupational decision problem hold for all periods but the first one. In the first period a fractionf_j of workers is exogenously assigned to occupation j. These workers find out their comparative advantage in that occupation but experience no ϵ shocks (i.e. their z is zero). In the second and subsequent periods they optimally choose their occupation as described above.

3.5 Equilibrium

Let's denote the policy function that describes the occupational decision of an individual of age s characterized by a realization ϵ, a set ω_s and productivity z, that is currently in occupation j' and switch to occupation j by $I_{j,s}(j', \omega, z, \epsilon)$.

For aggregation purposes it necessary to specify the position of individuals across states. Let $\Psi_{j,s}(\Omega_s, z, \epsilon)$ be the mass of individuals of age s in occupation j, with productivity z, shock ϵ, that have been in other occupations in the past with their respective ability, represented by Ω_s. The measure Ψ is defined for all the possible values of Ω_s z and ϵ which belong sets that are Borel subsets of $\mathbb{R}$. The dynamic evolution of the mass of individuals reads as follows.

As described above, the mass of newborns in each occupation is exogenously determined and given by f_j. Thus, for $s = 0$,

$$\Psi_{j,0}(\Omega_0, z, \epsilon) = \frac{1}{S} f_j \quad \forall \quad j \in \{1, ..., J\}.$$

In addition, since individuals live S number of years, we have that for $S + 1$,

$$\Psi_{j,S+1}(\Omega_S + 1, z, \epsilon) = 0 \quad \forall \quad j \in \{1, ..., J\}.$$

For $0 < s < S$, Ψ obeys the following recursion

$$\Psi_{j,s+1}(\Omega_{s+1}, z, \epsilon) = \sum_{j'} \Psi_{j,s}(\Omega_s, z, \epsilon) I_{j,s}(j', \omega_s, \epsilon) \quad \forall \quad j' \in \{1, ..., J\}.^{7}$$

The aggregate mass of efficiency units in each occupation is thus given by

[7] Note that j' can take the value j since there is a mass of individuals that were in j and stay in j.

$$N_j = \frac{1}{S}\sum_{s\in S}\int e^{z}e^{\theta_{j'}}e^{\epsilon_{j'}}d\Psi_{j,s}(\Omega_s, z, \epsilon) + \frac{1}{S}\sum_{s\in S}\sum_{j\neq j'}\int e^{-c(s,\kappa)}d\Psi_{j',s-1}(\Omega_{s-1}, z, \epsilon)$$

We can now define a stationary competitive equilibrium that consists of (i) a set of occupational wages $\{w_j\}_{j=1}^{J}$, (ii) occupation populations (or masses) $\{\psi_j\}_{j=1}^{J}$, (iii)a set of intermediate goods prices $\{p_j\}_{j=1}^{J}$ (iv) occupational-level efficiency-weighted employment levels $\{N_j\}_{j=1}^{J}$, (v) occupation-specific decision rules $\{I_{j,s}\}_{j=1}^{J}$ and associated value functions $V_s$that satisfy the following conditions:

1. The labor inputs N_j are the solution to the intermediate producer optimization problem.

2. The intermediate goods quantities X_j solve the final goods producer's problem.

3. Prices p_j equate supply and demand of intermediate goods.

4. Wages w_j is the marginal product of a marginal unit of average efficiency in occupation j.

$$w_j = \alpha_j N_j^{\alpha_j - 1}\prod_{j'\neq j}\left\{ {N_j}'^{\alpha'_j} \right\}$$

.

5. Labor markets clear at the occupational level.

6. In a given occupation j, Ψ_j is the stationary distribution.

By Walras's law, the market for the final good also clears.

4 Quantitative Analysis

4.1 Parameter Values

We separately calibrate our model economy to Germany and US data; the calibration strategy is identical for the two economies. There is a set of parameters common to the two countries and a set of parameters that differ. The common set of parameters includes the period frequency, the number of occupations J, the discount factor β, and the lifespan S.

We restrict the analysis to an economy with three occupations grouped according the level of risk: safe (S), medium (M), and risky R [8]. The model period is set equal to one year and a worker's lifetime S is 35 years. We restrict preferences to be of the constant relative risk aversion class with the coefficient of risk aversion equal to 3.

The values for the remaining parameters are country-specific. We choose values so that our model economy replicates features of the actual economy. We assume that the distribution of shocks to z and the distribution of abilities θ are normal:

$$\epsilon_j \sim N(-0.5\sigma^2_{\epsilon,j}, \sigma^2_{\epsilon,j}), \tag{23}$$

$$\theta_j \sim N(-0.5\sigma^2_{\theta,j}, \sigma^2_{\theta,j}), \tag{24}$$

for j in $\{S, M, R\}$. We also assume a quadratic mobility cost function $c(s, \kappa)$:

$$c(s, \kappa) = \kappa_0 + \kappa_1 s + \kappa_2 s^2 \tag{25}$$

Thee set of parameters that are country-specific is,

$$\Lambda = \left\{ \kappa_0, \kappa_1, \kappa_2, \left\{ \sigma^2_{\epsilon,j}, f_j, \sigma^2_{\theta,j}, \alpha_j \right\}_{j \in S,M,R} \right\}.$$

where we have included the new parameters f_S, f_M, and f_R that refer to the initial fractions of workers in each of the three occupations. It is important to note that we do not take the variances as estimated in the empirical part, we calibrate them. Since the econometric procedure does not take into account occupational change, in light of our model, it would underestimate the variance of earnings. The reason is simply selection since large shocks to labor earnings are the reason workers switch occupations.

[8] We grouped them such as the R and S groups each concentrate 25% of workers.

The value of some of these parameters can be calculated directly from the data. First, the parameters f_S, f_M, and f_R correspond to the fractions of the youngest group of workers in each of the three occupations. Of the 26 year-old, 32.5% work in the safe occupation in the US and 32.95% in Germany. For the medium and the risky occupations the fractions differ more across the two economies. For the medium risk occupation, the fraction is close to a half for Germany (47.62%) while it is less than 40% for the United States (38.2%). The labor share parameters α_j for $j \in \{S, M, R\}$ can be computed outside the model as well. As α_j represents the wage bill in occupation j as a share of the total wage bill, one can calculate α_j as total earnings in occupation j as a fraction of total earnings across all occupations.[9]

We choose the values for remaining country-specific parameters so that the model matches a set of moments from the data. Table 3 displays their values for the United States (first column) and for Germany (second column). We first consider the mobility of workers across occupations. In particular, we target that the model matches the average 2-year mobility rates for the young, middle-aged, and old. [10] As we did before, we compute 2-year mobility rates for each age group (for a total of 33 age groups). We then take the average of those for the 28-38 year olds (young), the 39-49 year olds (middle-aged), and those 50 or older (old). As noted before, mobility is much higher in the United States than in Germany and the difference is largest for young workers. In the United States, about 22.36% of young workers move in two years. This fraction drops to only 19.74% for the middle-aged, and to 17.97% for the older group. The corresponding figures for Germany are 4.1%, 2.1%, and 0.9%.

We also target (a) the variance of the log-earnings for the 26-year-olds (by occupation) and (b) the standard deviation of the permanent shocks to labor earnings, also by occupation. The methodology to calculate the standard deviation of the permanent

[9] Because production of the final good does not require capital, total output is equal to the total wage bill.

[10] Mobility rates now are defined as switches between our 3 occupations grouped by risk, not the original 12 occupations we considered earlier.

shocks follows that described in Section 2.1.2. Because we aggregate to 3 occupations, we compute the averages of the standard deviations calculated for our original group of 12 occupations (properly weighted).

The middle three rows of Table 3 show the variances of log earnings for the youngest age group in our sample for both Germany and the US. The variances in Germany are lower than those in the US by a factor of about 4 for the safest occupation (0.191 vs. 0.052) and a factor of roughly 2 for the riskiest (0.165 vs. 0.089). The variability of permanent shocks to earnings is also higher for US workers. So much so, that the variance of the riskiest occupation in Germany is equal to that of safest occupation in the United States (0.101). As expected, the calibrated variances of the permanent shocks to earnings (the "true" variances) are larger than those estimated directly from the data (the targeted moments).

Table 4 displays the values of the parameters for the United States and German economies. Mobility costs are higher in Germany than in the United States. Potentially, they could important in explaining the differences in occupational mobility between these two countries. However, below we show that these higher mobility costs matter little in explaining the differences in mobility rates. Thus, the main factor is the cross-country difference in the variability of shocks to θ and to ϵ. Table 5 shows the targeted moments and the model-simulated moments using the parameter values in Table 4, for the two economies.

Solving the model for the set of parameter values just described delivers an equilibrium distribution of earnings within and across occupations. In equilibrium, individuals' earnings depend on the occupation wage, and on the realizations of the occupation-specific abilities and the shocks to general human capital. In equilibrium average earnings within an occupation depend on the wage rate for that occupation and the efficiency units of the workers that selected into that occupation. However, insofar as the variances of the shocks affect the sorting of risk-averse workers, they influence the equilibrium distribution of earnings across occupations as well.

Besides the baseline model economy, we consider three counterfactual economies that are useful to explore the mechanisms present in the model. In addition, they serve as ways to analyze the differences between two countries in occupational mobility and, more importantly, the implications of their differences in social insurance policies embedded in their income tax schedules. In the first counterfactual we give the tax function of the other country to either the US or the Germany baseline economies. In the second counterfactual we force workers to face the other country's risk to general human capital. Finally, in the third counterfactual we set θ to zero, so that the ability in each occupation is 1 for each worker. In tables 6, 7 and 8 we present the results for the eight economies we consider (four economies for each country). In what follows we describe them for each of the experiments considered.

4.2 The Effect of Social Insurance: Tax Reforms

We first analyze the case of the US economy with the more progressive German income tax, the rest of the features of are maintained at its baseline levels. In the third column of table 6 present the results. We giving US workers the degree of social insurance that German workers enjoy occupational mobility rises. Now workers switch on average 4.3 times over their lifetimes (38.7 % higher than in the baseline). The average mobility rate over the life cycle is now 20 % (1.5 percentage points higher than in the baseline). The fact that workers now enjoy more insurance provides incentives to experiment more both by discovering their comparative advantage through trying different occupations but also because risky occupations become more attractive. More workers try risky occupations and also more move back to the safer ones as it is less likely to succeed in the risky occupations.

The higher mobility yields a better assignment of workers to occupations. That better assignment leads to sizable increases in output: it rises from 0.728 to 0.755 (an increase of 3.65%). Inequality rises (third line) taking the variance of log earnings from 0.7 to 0.722. Note, however, that earnings here refer to pre-tax earnings. More social insurance leads to a lower volatility of after-tax earnings. To summarize, more social insurance, everything else constant raises aggregate output and increases mobility.

The fourth column of 7 shows the shares of workers in each occupation as well as the equilibrium mean earnings. Both in baseline economy and in the counterfactual the medium risk occupation is the largest. The smallest is the risky. In addition, in both cases there is a positive correlation between the level of risk and mean earnings, confirming the results of Cubas and Silos (2017). The higher the risk the workers face the higher the mean earnings. Given the labor shares parameters this is the result of the sorting of workers. The higher the risk of the occupation the more selected the workers are and thus the higher the mean earnings in that occupation. Compared to the baseline economy, the economy with German taxes exhibits a larger risky occupation, almost the same size safe occupation, and a smaller the medium occupation. With more insurance, the risky occupation becomes more attractive and thus in equilibrium more workers select it. Since more workers select it, the mean earnings are lower than in the baseline economy. On the contrary,

In order to investigate the welfare effects of such a policy change we compute the consumption equivalent variation (CEV) which is the uniform percentage decrease in consumption, at each date and in each event, needed to make a household indifferent between being born into the baseline economy (the US tax system) and being born into the counterfactual economy (the US with the German tax system). Positive CEV thus reflect a welfare increase due to the change in the tax system, compared to the tax system of the baseline economy. Table 8 shows the results. In the second column we observe that when US workers enjoy the insurance of Germany there are substantial welfare gains, specifically 2.55%. In this counterfactual economy, US workers not only enjoy better consumption smoothing opportunities but also higher levels of consumption providing output increases.

In the same way, we perform the counterfactual exercise in which we give Germany the less progressive tax system of the US. Contrary to the previous case and, as expected, occupational mobility goes down. This is clear by observing the seventh column of Table 6 which shows the decrease of both the average times workers change occupations (from 0.45 in the baseline to 0.35) and the average mobility rate (from 2.5% to 2%). Because US labor taxation discourages risk taking, workers experiment less. The lower degree of experimentation leads to lower quality matches. Aggregate output suffers as a result, and relative to the baseline German economy, this counterfactual economy yields 2.6% fewer goods. Pre-tax earnings inequality, measured by the variance of log earnings falls as well. However, because US taxes are less progressive after-tax earnings inequality rises. By looking at the fifth column of Table 7 we see that the there is a substantial increase in the proportion of workers in the risky occupation. Compared to the baseline economy, this is a much safer economy as the variance of the shocks are much smaller (the variance of the shock of the safe occupation in the baseline US economy is the same as the variance of the shock of the risky occupation in Germany). As a result, the proportion of workers in the safe and medium risk occupations decreases. Consequently, mean earnings goes down in all occupation but much more in the risky one due to the inclusion of low productivity workers.

Regarding the share of workers in each occupation, the results of this counterfactual exercise are qualitatively similar. With less insurance, the fraction of German workers in the risky occupation is almost the same but there are fewer of them in the medium risk occupation and more in the safe one. Again, as is the case for the United States, there is compensation for risk in Germany. We also compute CEV for this case and find that there are substantial welfare losses, specifically in the order of 4.5% compared to the baseline German economy. As we show below, the combination of high earnings (i.e. consumption) volatility and lower output, is responsible for large welfare losses from adopting this policy.

We estimate the Logit regressions presented in the empirical part but using model generated data, that is, we use the output of our simulation. Specifically, we regress the occupational mobility and the realization of the negative shocks of the calibrated stochastic process. Table 9 shows the effect of insurance on occupational mobility. In the case of the US (column 2 and 3) as more insurance is provided to workers, the more they change occupations and thus the coefficient is negative and larger (in absolute value) than the baseline case. The same effect is observed for the case of Germany when we give their workers the lower level of insurance of the US, the coefficient is still negative but smaller in absolute value.

4.3 The Effect of Earning Shocks: US vs. Germany

Our second counterfactual is to give each of the baseline economies the earnings shocks of the other. In this way, we explore the implications of changing the magnitude of the permanent shocks to the general human capital (exogenous in our model) on the same set of macroeconomic aggregates.

We start by analyzing the US economy but now with the shocks of the magnitude estimated for Germany. As shown in the fourth column of table 6, as expected, when US workers face much lower permanent shocks to earnings, mobility rates drop substantially: the average mobility rate is almost 14 percentage points lower than in the baseline economy (from 18.5% to a value of 4.9%). The average occupational changes fall from 4.3 to 0.97. This drop implies that the lower volatility of shocks in Germany is responsible for the low mobility rates observed in Germany. Higher mobility costs play a minor role. Because the high productivity workers are much less productive - the right tail is much shorter now, aggregate output falls by close to 40%. Earnings inequality falls almost in the same proportion as well since there is less experimentation due to the fact workers have less risk taking opportunities and as a result, the equilibrium earnings distribution shrinks.

Although output significantly drops, workers now live in an economy with permanent shocks that are substantially lower in magnitude (the variance of shocks are on average quarter of the ones estimated for the baseline economy) and thus this effect dominates and as a results renders a welfare gain of 3.73% (see the third column in table 8).

In the same way, we give German workers the permanent shocks of the US economy. Everything else equal, German workers will now live in a much riskier economy, although this economy will offer them better opportunities. As a result occupational mobility substantially increases as shown in the fourth column of table 6. The average occupational change during a worker lifetime goes from 0.35 to 2.16 and the average mobility rate increases almost 10 percentage points (from 2% to 11.8%). As noted before, the magnitude of the permanent shocks explain the bulk of the cross-country differences in the observed occupational mobility. The large increase in mobility results in a a better sorting of workers and thus in a substantially higher level of output which increases by 23%. Due to the better sorting inequality increases.

As in the case of the tax reforms we run the Logit regressions using the output of the model in these counterfactual exercises. Table 9 shows the effect of the shocks on occupational mobility. In the case of the US (column 2 and 4) as worker face shocks that are lower in magnitude compared to the baseline, the propensity to change occupations decreases. On the contrary, when we make German workers to face the larger shocks of the US, the propensity to move increases.

4.4 The Case of Homogenous Workers

The last counterfactual economy we examine is one in which there is no heterogeneity in ex-ante abilities to work in different occupations, or comparative advantage. Specifically, in this counterfactual economy, abilities for working in different occupations are the same and normalized to unity. In this way we shut down the mobility that occurs for the process of discovery of worker's comparative advantage.

In both countries, occupational mobility raises (see columns 5 and 9). Without occupational specific abilities workers have worse matches to occupations and thus they are less attached to them. As a result, for the same shocks they move more than in the baseline case. The changes in the shares of workers in each occupation are small compared to the previous counterfactuals and mean earnings in each of them change in the same direction observed before.

As already mentioned, the fact θ is set to 1, produces worse matches of workers into occupations when compared to the baseline case in which workers have occupation-specific abilities. This worse sorting lowers productivity, and output as a result. Output is 13% lower in the case of the US and 8.5% lower in the case of Germany. Although occupational mobility is higher, the fact that workers are much more similar compared to the baseline case (ex-ante homogeneous) implies pre-tax earnings volatility also falls in both countries. For the US the variance of log earnings goes from 0.7 in the baseline to 0.559 when θ is 1. In Germany the variance of log earnings drops from 0.179 to 0.127. Interestingly, these experiments allows us to explore the sources of earnings inequality. In the case of the US, the size of the drop in the variance of log earnings in the counterfactual exercise shows that about 20% of the inequality is due to shocks to θ while the remainder is due to ϵ-shocks. In Germany, 30% of the inequality is due to shocks to θ.

5 Concluding Remarks

This paper uncovers a new mechanism through which social insurance policies affects the sorting of workers in the labor market. It does so by proposing a dynamic framework in which worker's comparative advantages interact with the earnings risk they face to determine their career choice.

We documents new facts on earnings risk and its relationship with occupational mobility for Germany and the United States. We find that workers experience substantial earnings uncertainty and that earning shocks are occupation-specific. In addition, cross-country differences in earnings volatility explain the bulk of differences in occupational mobility across countries.

When insurance opportunities are limited, workers respond to adverse earnings outcomes by changing occupations. Workers learn the occupation-specific abilities through experimentation in the labor market. Experimentation is costly because of uncertainty. Social insurance provides incentives to take on more risk and thus encourages experimentation. Better insurance improves the sorting of workers into occupations. Our quantitative results show that better insurance leads to substantial increases in output and welfare as well as changes in pre-tax earnings inequality.

In order to focus on the main mechanism we propose, the paper abstracts from many important aspects of the labor market that potentially affect the individual's occupational choice. One important aspect of our exercise is that we take earnings volatility as exogenous. We hope our findings in terms of its importance on occupational mobility and sorting as well as the differences we find between US and Germany, encourages future research on the the forces that generates the observed variances. For instance, it would be worth exploring the role of labor market institutions and technological change in explaining cross-country differences in the variance of shocks.

Another important dimension from which we abstract is the the intensive margin of labor supply. It is well known the negative effect of social insurance policies in the labor supply of workers, in particular of progressive taxation. These abstractions must be taken into account when interpreting our findings. Nevertheless, we provide a quantitative assessment on the importance of volatility of earnings and social insurance policies in the occupational choice of workers as well as their welfare implications, both ignored so far.

We think our paper offers a new perspective to understand labor markets as well as providing new insights on the welfare effects of missing insurance markets. For instance, our results related to inequality shed light on the effect of policies targeted to modify initial conditions and those directed at shocks over an individualâĂŹs working lifetime.

Although we abstract from many important dimensions we think our framework is general enough to be applicable to many future research avenues. For instance, we consider only one particular insurance policy but, conditional on tractability, our framework is flexible enough to incorporate other type of policy measures such us transfer schemes. In addition, the model could be enriched by incorporating the possibility of self-insurance, financial constraints as well a rich asset structure the workers participation in such markets to better understand the interaction of private insurance and social insurance and their effect in the career choice. Moreover, our model could serve to understand other type of labor disparities, for instance, gender differences in the labor market and the effect of risk associated with the spatial location of workers. Finally, our framework does not address several forces that shape individualsâĂŹ skills: for example, occupation-specific human capital accumulation to better understand how individuals build their occupation-specific abilities.

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Tables

Table 1: Standard Deviation Permanent Shock

	US			Germany		
Occupation	σ_ϵ	Ranking	No. Workers	σ_ϵ	Ranking	No. Workers
1 Professionals and Technicians	0.091	4	436	0.096	5	1326
2 Athletes, Artists, Religion	0.198	11	313	0.128	11	693
3 Managerial Workers	0.128	8	674	0.149	12	681
4 Clerical Workers	0.113	6	448	0.058	1	1502
5 Administrative Workers	0.064	1	281	0.114	9	899
6 Sales Workers	0.206	12	335	0.102	6	812
7 Service Workers	0.089	3	319	0.073	3	1641
8 Teachers	0.124	7	404	0.113	8	825
9 Medical Workers	0.186	10	451	0.114	10	177
10 Manufacturing Workers	0.088	2	179	0.059	2	480
11 Production Workers.	0.130	9	516	0.106	7	1777
12 Constructors, Painters, Transportation	0.104	5	634	0.075	4	1447
Weighted Average	0.130			0.093		

Table 2: Logit Regression: United States vs. Germany

	United States	Germany
$\hat{v}^-$	-0.030	-0.043
	(0.010)	(0.005)

Note: The table displays the results of running a logit regression of the occupation switching decision on the negative of the earnings residuals ($u^{-1} = \min\{u, 0\}$) (second and third columns). The second column show result for the PSID and the third column show result for the SOEP.

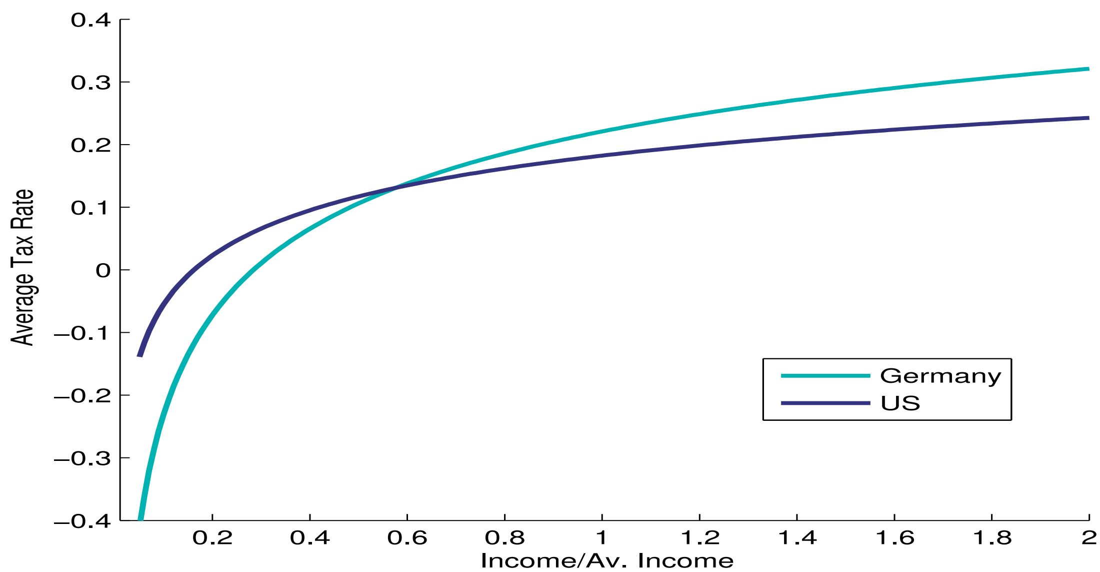

Figure 1: The figure plots the tax functions for Germany and US estimated in Holter, Krueger and Stepanchuk, 2016

Table 3: Targeted Moments: United States and Germany

	USA	Germany
Mob. Rate Young	0.224	0.041
Mob. Rate Mid-Age	0.197	0.021
Mob. Rate Old	0.180	0.010
Var. Log Earnings S	0.191	0.052
Var Log Earnings M	0.159	0.063
Var. Log Earnings R	0.165	0.089
Std. Dev. Risk S	0.101	0.063
Std. Dev. Risk M	0.146	0.075
Std. Dev. Risk R	0.217	0.101

Table 4: Estimated Parameters: United States and Germany

	USA	Germany
κ_0	1.174	1.625
$\kappa_1(10^{-3})$	1.273	0.240
$\kappa_2(10^{-3})$	-0.942	-0.808
$\sigma_{\epsilon,S}$	0.109	0.063
$\sigma_{\epsilon,M}$	0.158	0.076
$\sigma_{\epsilon,R}$	0.271	0.101
$\sigma^2_{\theta,S}$	0.191	0.052
$\sigma^2_{\theta,M}$	0.159	0.063
$\sigma^2_{\theta,R}$	0.165	0.089

Table 5: Model Fit (Data vs. Model): United States and Germany

	United States		Germany	
	Data	Model	Data	Model
Mob. Rate Young	0.224	0.221	0.041	0.046
Mob. Rate Mid-Age	0.197	0.169	0.021	0.019
Mob. Rate Old	0.180	0.168	0.010	0.009
Var. Log Earnings S	0.191	0.190	0.052	0.052
Var Log Earnings M	0.159	0.159	0.063	0.063
Var. Log Earnings R	0.165	0.164	0.089	0.089
Std. Dev. Risk S	0.101	0.102	0.063	0.062
Std. Dev. Risk M	0.146	0.143	0.075	0.075
Std. Dev. Risk R	0.217	0.212	0.101	0.101

Table 6: Model Summary : Baseline vs. Counterfactuals

	United States				Germany			
	Baseline	Taxes GER	Shocks GER	No θ	Baseline	Taxes USA	Shocks USA	No θ
Avg. Occ. Changes	3.916	4.303	0.970	5.321	0.446	0.350	2.161	0.371
Avg. Mob. Rate	0.185	0.200	0.049	0.265	0.025	0.020	0.118	0.022
Var. Log Earnings	0.700	0.722	0.230	0.559	0.179	0.179	0.537	0.127
Aggregate Output	0.728	0.755	0.444	0.633	0.382	0.372	0.468	0.350
Rel. to Baseline								
Avg. Occ. Changes (Δ)		0.387	−2.946	1.406		−0.096	1.715	−0.075
Avg. Mob. Rate (Δ)		0.015	−0.136	0.081		−0.005	0.093	−0.003
Var. Log Earnings (Δ)		0.022	−0.470	−0.141		−0.000	0.358	−0.053
Aggregate Output (Δ%)		3.65%	−39.06%	−13.07%		−2.63%	22.58%	−8.47%

Table 7: Model Summary : Baseline vs. Counterfactuals

		United States				Germany			
		Baseline	Taxes GER	Shocks GER	No θ	Baseline	Taxes USA	Shocks USA	No θ
Occ. Shares	Safe (S)	0.319	0.320	0.228	0.341	0.247	0.257	0.376	0.254
	Medium (M)	0.465	0.456	0.424	0.414	0.423	0.409	0.388	0.416
	Risky (R)	0.215	0.224	0.347	0.245	0.331	0.334	0.237	0.330
Mean Earnings	Safe (S)	0.476	0.491	0.405	0.388	0.352	0.334	0.298	0.320
	Medium (M)	0.672	0.712	0.447	0.657	0.368	0.366	0.481	0.338
	Risky (R)	1.224	1.217	0.465	0.933	0.422	0.409	0.717	0.387

Table 8: Welfare Gains Relative to Baseline

	United States		
	Taxes GER	Shocks GER	No θ
% Welfare from Baseline	2.55	3.73	1.60
	Germany		
	Taxes USA	Shocks USA	No θ
% Welfare from Baseline	−4.55	−9.09	1.31

Table 9: Logit Regression: Model-Simulated Panel

	United States		Germany	
	Baseline	Taxes GER	Baseline	Taxes USA
u^-	-0.689	-0.812	-0.056	-0.042
Age	-31.805×10^{-4}	-47.194×10^{-4}	-2.586×10^{-4}	-2.350×10^{-4}
Age^2	0.410×10^{-4}	0.841×10^{-4}	0.006×10^{-4}	0.016×10^{-4}

Note: The table displays the results of fitting a logit model to the occupation switching decision on the negative of the earnings residuals ($u^{-1} = \min\{u, 0\}$) (first column and third columns), age, age squared, and occupational dummies (coefficients not shown). The first four columns show results for the model economy calibrated to US data and the counterfactuals described in the text. The last four columns show analogous coefficients for the economy calibrated to Germany and its counterfactuals.

Appendix

6 Data and Sample Selection

The main data sources are US Panel Study of Income Dynamics (PSID) and the German Socio-Economic Panel (SOEP) provided by the Cross-National Equivalent File (CNEF) at Ohio State University. The CNEF define a set of variables of these data sets in a consistent way so the data sets that are comparable.[11]

For the PSID we use the data from 1981 through 2007 (its last available year) whereas for the SOEP we use the data from 1984 through 2012 (its last available year). Our sample selection procedure can be summarized as follows:

- Restrict individuals to be between the ages of 26 to 60.
- We eliminate individuals that are not employed and those with zero earnings and zero hours of work.
- We eliminate individuals for which the information on sex, marital status and education is missing.
- Restrict individuals who are employed and report annual hours of work larger than 1040 and less than 5110.
- We use earnings in real terms that are obtained using a CPI deflator for US and Germany. In the case of the US we eliminate those with earnings per hours larger than one and less than 300 (in 1983 dollars). For the German data we eliminate those whose earnings per hour are larger than 8.5 euros and less than 572 (in 2010 euros).
- Restrict analysis to individuals with at least 8 consecutive periods of data.

[11] The CNEF provides data for other countries as well, some of them are publicly available at https://cnef.ehe.osu.edu/data/ (this is the case of the PSID), while for other countries (i.e. SOEP) there are additional steps to follow to obtain the data.

- We eliminate individuals for which the industry or occupation classification is missing.

- For the US, the CNEF data on occupations is provided following the ISCO68 classification of the International Labor Organization (ILO). The SOEP data on occupations is provided following the 4-digit ISCO88 classification, a revision of the ISCO68 coding made made by the ILO. The CNEF provides the conversion of occupations from the ISCO88 coding to the ISCO68 coding to make the two countries comparable. The CNEF provides data on 83 different occupations and the categories correspond to either specific 2-categories or sub-groups of the ISCO68. We further group occupations since after all the restrictions we impose in the sample we end up with very few workers in some occupations. We group them by closely following the criteria of ISCO68 to group occupations according to their similarities in the skills required to perform them. The ISCO68 major groups are 9, in our case we end up with 12 occupational groups, we specify them in Table A.2. We eliminated Soldiers, Farmers, Agricultural and Animal Husbandry Workers, Forestry Workers and Fishermen, Hunters and Related Workers.

Table A.1: Occupation Classification

Occupation	CNEF Occupations
1 Professionals and Technicians	Physical Scientists and Related Technicians; Architects, Engineers and Related Technicians; Aircraft and Ships' Officers; Life Scientists and Related Technicians; Statisticians, Mathematicians, Systems Analysts and Related Technicians; Economists
2 Athletes, Artists, Religion	Accountants; Jurists; Workers in Religion; Authors, Journalists and Related Writers; Sculptors, Painters, Photographers and Related Creative Artists; Composers and Performing Artists; Athletes, Sportsmen and Related Workers; Professional, Technical and Related Workers Not Elsewhere Classified
3 Managerial Workers	Legislative Officials and Government Administrators; Managers
4 Clerical Workers	Clerical Supervisors; Government Executive Officials; Clerical and Related Workers Not Elsewhere Classified
5 Administrative Workers	Stenographers, Typists and Card- and Tape-Punching Machine Operators; Bookkeepers, Cashiers and Related Workers; Computing Machine Operators; Transport and Communications Supervisors; Transport Conductors; Mail Distribution Clerks; Telephone and Telegraph Operators
6 Sales Workers	Managers (Wholesale and Retail Trade); Sales Supervisors and Buyers Technical Salesmen, Commercial Travellers and Manufacturers' Agents; Insurance, Real Estate, Securities and Business Services Salesmen and Auctioneers; Salesmen, Shop Assistants and Related Workers; Sales Workers Not Elsewhere Classified
7 Service Workers	Managers (Catering and Lodging Services) Housekeeping and Related Service Supervisors Cooks, Waiters, Bartenders and Relaters Workers Maids and Related Housekeeping Service Workers Not Elsewhere Classified Building Caretakers, Charworkers, Cleaners and Related Workers Launderers, Dry-Cleaners and Pressers Hairdressers, Barbers, Beauticians and Related Workers Protective Service Workers; Service Workers Not Elsewhere Classified
8 Teachers	Teachers

Table A.2: Occupation Classification

9 Medical Workers	Medical, Dental, Veterinary and Related Workers
10 Manufacturing Workers	Production supervisors and general foremen
	Miners, Quarrymen, Well Drillers and Related Workers
	Metal Processers; Wood Preparation Workers and Paper Makers
	Chemical Processers and Related Workers
	Spinners, Weavers, Knitters, Dyers and Related Workers
	Food and Beverage Processers
	Tailors, Dressmakers, Sewers, Upholsterers and Related Workers
	Shoemakers and Leather Goods Makers; Cabinetmakers and Related Woodworkers
	Stone Cutters and Carvers; Blacksmiths, Toolmakers and Machine-Tool Operators
	Machinery Fitters, Machine Assemblers and Precision Instrument Makers (except Electrical)
	Electrical Fitters and Related Electrical and Electronics Workers
	Broadcasting Station and Sound Equipment Operators and Cinema Projectionists
	Plumbers, Welders, Sheet Metal and Structural Metal Preparers and Erectors
	Jewellery and Precious Metal Workers
	Glass Formers, Potters and Related Workers
12 Constructors, Painters, Transportation	Printers and Related Workers; Painters
	Production and Related Workers Not Elsewhere Classified
	Bricklayers, Carpenters and Other Construction Workers
	Stationary Engine and Related Equipment Operators
	Material-Handling and Related Equipment Operators, Dockers and Freight Handlers
	Transport Equipment Operators; Labourers Not Elsewhere Classified