

Economic Brief

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Sorting in the Labor Market

By [Katarína Borovičková](#)

Do high-ability workers typically work for more productive firms? If so, then we say there is positive sorting between firms and workers in the labor market. In this article, we review evidence on sorting and conclude that it is positive and has been increasing for men in the last several decades. Stronger positive sorting is viewed as one reason behind increasing wage inequality.

There is sorting everywhere in the economy:

- Wealthier, more educated, more attractive men on average marry wealthier, more educated, more attractive women.¹
- Higher-income households reside in distinct neighborhoods and send their children to better schools than low-income households.²
- Elite universities enroll the most qualified undergraduates.³

One place where it has been hard to find evidence of sorting is in the labor market. There is an extensive literature following the seminal 1999 paper "[High Wage Workers and High Wage Firms](#)" — widely known as the AKM paper after its authors John Abowd, Francis Kramarz and David Margolis — which finds that the correlation between the worker fixed effects and firm fixed effects is close to zero, possibly negative. Fixed effects in this context capture wage premia earned by a worker or paid by a firm. That is, a high fixed-effect worker is someone who earns higher wages than predicted by her demographic characteristics. Similarly, a high fixed-effect firm is a firm that pays higher wages than predicted by its characteristics. The correlation of zero is often interpreted as saying that there is no evidence that high-fixed effect workers typically work for high fixed-effect firms, and so there is no sorting in the labor market.

While it might sound like high fixed-effect workers have to be employed by high fixed-effect firms, this is not true: A high fixed-effect worker earns a higher-than-predicted wage no matter where she works. The question is whether high fixed-effect workers — called high-

wage workers in the AKM paper — typically work for high fixed-effect firms (called high-wage firms) or not.

Traditional Measure of Sorting

The AKM paper was the first to use detailed matched employer-employee data to study wage dispersion when it examined the French labor market. The paper seeks to answer why workers with the same demographic characteristics (such as gender, age, tenure, occupation and location) earn different wages.

One possible explanation is that workers differ in their abilities even when they have the same observable characteristics, and workers with higher ability simply earn higher wages. Another possibility is that some workers work for more productive firms, which pay higher wages. Worker ability and firm productivity are not directly observed in the data and hence could not be included in the set of observable characteristics.

However, if worker ability and firm productivity do not change over time, and workers are employed in several firms over their careers, it is possible to estimate worker and firm fixed effects, which can be interpreted as a measure of unobserved worker ability and firm productivity. The correlation between these fixed effects can then be interpreted as a measure of sorting. If the correlation is positive, it means that high-ability workers tend to work in highly productive firms. If it is negative, then high-ability workers tend to work for low-productivity firms. If it is zero, then there is no sorting, which is the finding in the AKM paper.

Issues With the Traditional Measure of Sorting

Recent literature points out that there are econometrics problems with the AKM regression, which can explain the low correlation. This regression suffers from the so-called incidental parameter problem, because the number of parameters that need to be estimated (one fixed effect for every worker in the sample and one fixed effect for every firm) grows as the sample size increases. Unless workers change firms frequently, fixed effects are estimated with a bias, and the bias has been shown to decrease correlation between firm and worker fixed effects.

A New Measure of Sorting

In my working paper "[High Wage Workers Work for High Wage Firms](#)" — co-authored with Robert Shimer — we propose a new measure of sorting between workers and firms in the labor market, which does not suffer from the incidental parameter problem.

Our measure of sorting is the correlation between a worker's type and her employer's type. We define a worker's type as the expected wage a worker receives in an employment relationship conditional on taking the job. That is, if we could observe a worker for a long time, her type would be the average wage she receives. Similarly, we define a firm's type to

be the expected wage that it pays to an employee conditional on hiring the worker, or equivalently the average wage paid over time. Using guidance from economic theory, we think of high-wage workers as those with higher abilities and high-wage firms as those with higher productivity, even though this cannot be directly verified in the data due to the fact that ability and productivity are not directly observed in the data.

Using several structural models of the labor market, we show that our measure captures the notion of sorting in these models. We then develop an estimator of this sorting and show that it is consistent in datasets where workers switch firms only very rarely, as is the case in real-world data.

Evidence of Sorting

We measure the correlation between worker and firm types using a panel dataset from the Austrian social security registry, the Arbeitsmarktdatenbank (AMDB, Labor Market Database). It covers the universe of workers in the private sector from 1986 to 2018. For each worker, the dataset contains information about every job they have held. More precisely, in every calendar year and for every worker-firm pair, we observe annual earnings and days worked during the year. The dataset further contains limited information on workers and firms, including workers' birth years and sexes and firms' regions and industries.

We focus on workers between age 20 and 60, and we look separately at men and women but recognize that selection into employment may be a more serious issue for women. For example, we do not have an indicator of part-time jobs, which are not prevalent among men but are among women: Between 1994 and 2007, on average 4.7 percent of employed men and 34.0 of employed women worked part time. Thus, caution is required when interpreting the results for women.

We find that the estimated correlation between types is around 0.44 for men and 0.42 for women. Recall that correlation lies between -1 and 1, and that previous literature found the correlation to be zero or even negative. Estimated correlation of 0.45 is therefore high, and so we conclude that high-wage workers typically work for high-wage firms, which is evidence of sorting.

Is a Firm an Equally Good Employer to All Its Workers?

Large firms employ workers from different occupations, and they might not be able to create the same conducive environment for all their workers. This could be due, for example, to a firm's specialization toward one occupation: It can provide a dynamic environment for this one occupation but might not be able to replicate this for occupations not central to its business goals.

So far, we assume that a firm has the same type for all its employees. We now relax this assumption by effectively breaking a firm into different types for employees with different skill levels and estimate the correlation between types on this adjusted dataset. We use five different education categories:

- No completed education
- Middle school
- Technical secondary school
- Academic secondary school
- College

We find that allowing firm types to differ by educational category raises the correlation of worker wages and firm wages between matched types from 0.44 to 0.52 for men and from 0.42 to 0.50 for women. This is consistent with the view that firms are a collection of heterogeneous jobs, and so ignoring that heterogeneity causes us to underestimate the true correlation.

We proceed in a similar way with position type (blue collar and white collar) and with industry categories. We again find that adding these variables substantially raises the estimated correlation. Regarding position types, correlations rise to 0.53 for men and 0.52 for women. Regarding industry categories (of which we use 10), correlations rise to 0.58 for men and 0.53 for women.

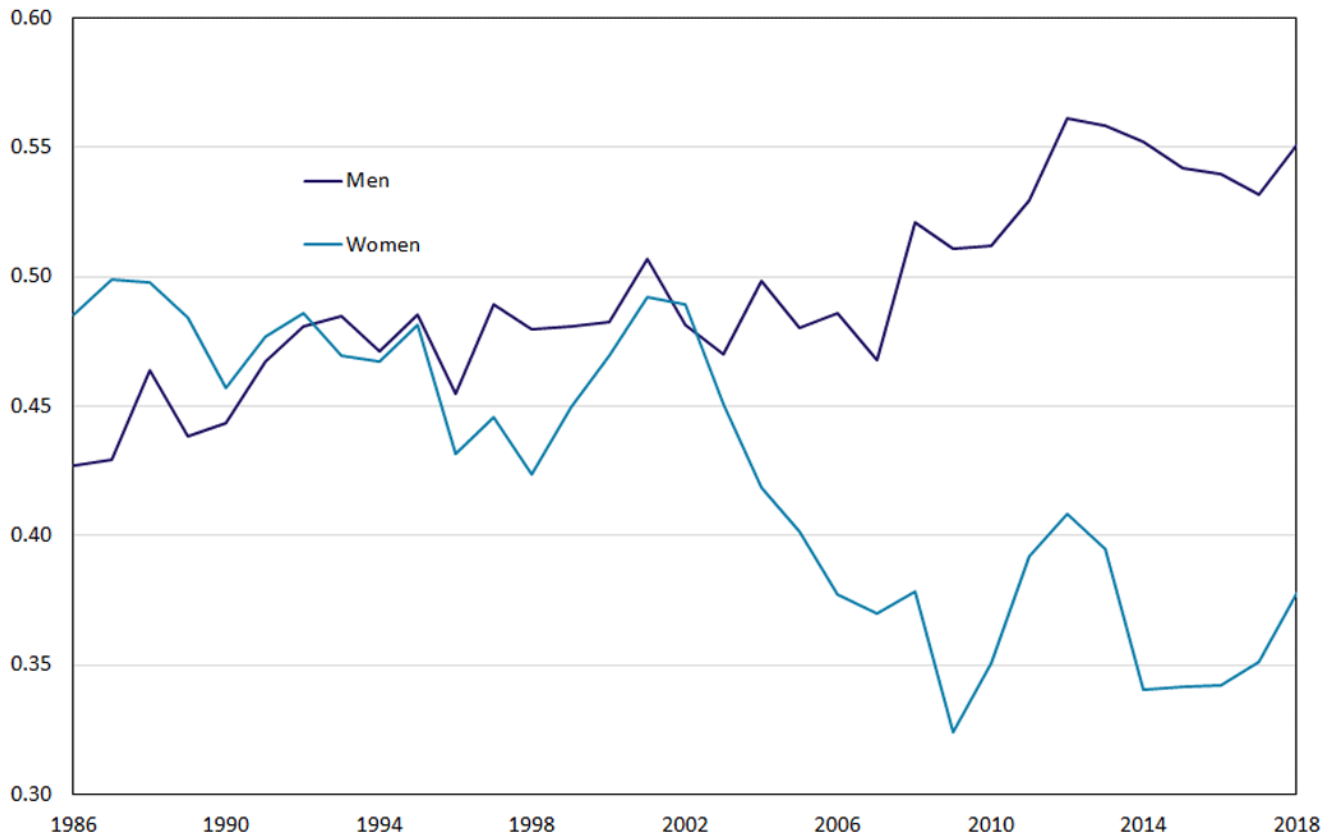
In summary, treating firms as a single type for workers with different observable characteristics significantly understates the amount of sorting in the economy, because it ignores that firms are collections of heterogeneous jobs.

Sorting Became Stronger for Men, Not for Women

We have assumed that workers' and firms' types do not change over time. This might be a strong assumption, as it is likely that workers accumulate skills during their careers. Similarly, firms can become more productive over time by adopting new technologies or improving management practices.

Our methodology allows us to handle time-varying types. We assume that types are fixed within a calendar year but can change over longer periods. We then redo our analysis using only a single year's data at a time, with Figure 1 showing the evolution over time.

Figure 1: Evolution of Sorting Over Time



Notes: The lines show the estimated correlation between worker and firm types over time.

Source: Author's calculation using Austrian social security data and methodology described in the 2017 paper "High Wage Workers Work for High Wage Firms."

[Enlarge](#)

Figure 1 shows that the correlation between worker and firm types increased slightly for men, from 0.43 in 1986 to around 0.49 in 1997, where it stayed until 2007. We see another increase in correlation in the last 10 years, reaching 0.55 in 2018.

The figure also shows a general downward trend in the correlation for women. However, we are cautious in interpreting the decline in the correlation for women as solely reflecting a decline in strength in sorting. As noted earlier, we do not observe whether jobs are part time or full time. We calculate daily wage by dividing annual earnings by days worked. If two jobs have the same hourly wage but one is part time and one is full time, our daily wage for the part-time job will be half of the full-time job. The share of women working part time has been increasing, which we believe is a factor in declining correlation. The share of part-time males, on the other hand, has been constant and not very high. Thus, we believe the increasing correlation for men indeed reflects stronger sorting.

Implications of Sorting for Wage Inequality

Why is it important to understand sorting? Sorting between workers and firms can have significant implications for wage inequality. Wages increase according to both worker skill and firm productivity. A high-skill worker receives a higher wage than a low-skilled worker if they work for the same firm. Similarly, a more productive firm tends to pay a higher wage

than a less productive firm to any given worker. Hence, if high-skill workers are typically employed by highly productive firms, their wages increase substantially. At the same time, low-skilled workers typically employed by low-productivity firms earn low wages. Therefore, stronger sorting contributes to widening the gap between high and low earners.

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¹ See, for example, the 1973 paper "[*A Theory of Marriage: Part I.*](#)"

² See, for example, the 1956 paper "[*A Pure Theory of Local Expenditures.*](#)"

³ See, for example, the 1975 book chapter "[*The Definition of College Quality and Its Impact on Earnings \(PDF\).*](#)"

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