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Are the Number of Skilled Workers Running Out in Germany? The (Non)–Consequences of Demographic Change

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Abstract

Two stylised facts of the German labour market are that first, the demand for (high-)skilled labour has been growing rapidly for a number of years and second, the country is facing a particularly strong demographic change with the expected size of the population decreasing rapidly and the average age of the labour force increasing sharply. This has led to a widely discussed fear of "labour-market shortages" whereby employers simply cannot find "enough" workers because many more are retiring than younger cohorts are entering. Although there is a simple logic in this argument, it is not beyond doubt, because firstly it is neither clear whether the labour demand side could not counteract this effect nor secondly to which precise situation the description "shortage" actually refers to. We address both issues from a theoretical and empirical perspective. We find no evidence that a high number of retirees across occupations leads to a higher demand for younger workers. Instead, to a large extent, retirees seem to be "replaced", if they are replaced at all, by middle-aged cohorts who change occupations.

Keywords: Labour-Market; Demography; Replacement Demand

JEL-Classification: J11; J21; J26

Introduction

Demographic projections for many countries suggest that population ageing is likely to accelerate over the next 50 years. Germany is a particular interesting country for studying the impact of demographic changes on labour markets. The demographic change in Germany is relatively fast as compared to other European countries or the US, for example. The relative size of the labour market entry cohorts has been decreasing significantly since the 1980s and are now roughly 10 percentage points lower. According to United Nations (2012), amongst the OECD countries, between 2010 and 2025 only the populations in Japan and Hungary are predicted to decline more rapidly than Germany's. By 2050, in addition to these two countries, only Poland, Portugal and Estonia's population will decrease faster.

In the literature the subject of ageing populations is receiving increased attention.¹ The issues addressed include the impact of ageing on growth rates (see, for example Bloom/Canning/Fink, 2010) or productivity (see, for example Bloom/Sousa-Poza, 2013; Mahlberg et al., 2013; Prettnier/-Bloom/Strulik, 2013; Zwick/Göbel, 2013) and changing patterns of consumption and saving or the implications for the public finances of rising expenditure on pensions, social security, social care, and health care. Focussing on the labour-market, D'Addio/Keese/Whitehouse (2010) analyse the general impact for the labour market of changing effective retirement rates.

At the same time as the expected demographic changes in Germany, in addition, employment of the high-skilled (i.e. those holding academic degrees) has been increasing enormously: in the last 10 years by around a third. Thus, it is not astonishing that recently, namely in the aftermath of what Paul Krugman called "Germany's job miracle" (for a discussion see Möller, 2010; Burda/Hunt, 2011), an intensive political debate has resumed, addressing the risk of (skilled) labour shortages in Germany. Some observers argue that the shrinking population size is likely to lead to skilled labour shortages because vacant jobs, especially those of the high-skilled, cannot be filled any more because there are not enough young people to "replace" them. For example, in a study by the Cologne Institute for Economic Research on behalf of the Association of German Engineers (*Verein deutscher Ingenieure (VDI)*), in 2011 there were an average of 72,000 vacancies for engineers which could not be filled. They calculate the economic loss in GDP at roughly 8 billion Euros.

In this paper, we analyse the shortage assertion both from a theoretical and from an empirical point of view. We discuss the question from the point of view of replacement demand, i.e. how many of the older workers who retire will be "replaced" as this is one transmission mechanism through which changes in labour supply are thought to transform into shortages. Further, it is an argument often heard in the debate on labour shortages: The argumentation is very simple: As in a certain occupation in the next years a high number of people will retire, there will be a shortage because there are fewer young people. A number of papers have attempted to estimate replacement demand (see, for example, Willems/de Grip, 1993; Shah/Burke, 2001; Fox/Comerford, 2008).

¹ See, for example, the special issue of the Oxford Review of Economic Policy, Volume 26, Number 4 in 2010.

Generally, they analyse replacement demand in the context of flow identities, i.e. summing total in- and outflows taking changes in total population size due to births, deaths and immigration into account.² This is then used to forecast future replacement demand. The aim of this paper is first to undermine the replacement demand argument more thoroughly from a theoretical perspective especially in light of the expected demographic changes. The question is hence, when will firms want to replace retiring employees when at the same time, for example, the average age of the labour-force population is increasing. Second, using our approach, we are able to answer whether this kind of mechanism has been present in the past where continuously smaller cohorts entered the labour market and thus the effect should – at least if it plays a role – have been present.

In order to contribute to the question whether replacement demand is likely to cause labour shortages, we first analyse demographic changes in the context of a matching model. In line with the replacement-demand argument, we find that a decrease in the number of people entering the labour market, for example due to a decline in birth rates, lowers equilibrium unemployment. However, the fact that at any given moment in time more people are retiring because the average age of the working population is increasing, does not lead to lower unemployment rates. On the contrary, the fact that the duration of expected job matches decreases means that creating new jobs is now less profitable. In addition, the decrease in labour supply leads to higher wages which further reduces labour demand. In our view, these theoretical findings undermine the fact that the replacement-demand argument is too simple as labour-market adjustments are not adequately taken into account.

To test the replacement demand hypothesis empirically, we use aggregate data on employment across age groups and occupations for the years 1987 to 2011 and micro data to 2008 to identify occupational changes. In addition, we analyse the hypothesis of Freeman (2006), who asserts that occupations with a high share of old individuals are growing more slowly, i.e., we test whether employment in occupations which are heavily affected by retirement is decreasing faster, at the same speed or more slowly than market segments which are not strongly affected by retirement. First, we find that occupations with a high share of older persons in Germany do not grow more slowly or faster than other occupations. Thus, it does not seem to be the case that "old occupations" on average are those occupations that vanish. Second, we provide evidence that across occupations the young cohorts are unlikely to actually replace the old cohorts. Large exiting cohorts in an occupation are not accompanied by many youngsters in this profession afterwards. However, we show that in the case where large exiting occupational cohorts are replaced, this is likely to be accomplished by the middle aged cohorts. We find them significantly more often in these occupations, when a few years before there has been a large old cohort. We interpret these results as pointing to the significance of occupational changes, since we control for the size of this group in the same occupation a few years before.

² More precisely, they differentiate between expansion demand caused by job growth in an occupation and replacement demand which is demand caused by outflows from an occupation.

Using micro data, we further analyse whether market conditions as driven by demographic changes explain occupational changes. More precisely, we show that job terminations in general and occupational changes in particular are less likely to occur when the market segment is affected by heavy retirement. In addition, we provide evidence that the middle-aged cohorts reaction on market condition is strongest, confirming our results from the above analysis. This further points to the significance of occupational changes as adjustment mechanism as is stressed in our theoretical model. We also analyse whether more persons choose a certain profession when there are large exiting cohorts and whether we can find evidence that this affects their career outlook.

Our findings have severe policy implications since it stresses the importance of occupational mobility as compared to the significance of the vocational training choice. From our results it is not clear that young people should be advised to choose occupations with a large replacement demand, i.e. occupations with large exiting cohorts. This is even true for growing occupations: i.e., even prior knowledge on the development of an occupation over time would not be sufficient to give this advice.

Theoretical Considerations

In a neoclassical setting, typically, changes in population size translate into changes of labour supply, wages and respective changes in employment. For example, a decrease in labour supply *c.p.* leads to a higher wage. Although total employment decreases as a result, the labour market still clears and at market wages there is no demand which is not met by supply. Thus, unfulfilled replacement demand whereby it is not possible to replace older workers with younger ones does not occur. In the new equilibrium, firms can hire as much labour as they demand and there is no "shortage" of any type of labour. Hence, in order for the replacement demand argument to hold in theory, the labour market must be imperfect to some extent. Obviously the same is true for the existence of unemployment. A typical neoclassical setting would have difficulties to account for unemployment. Note however, that there is an important difference between unemployment and labour shortage: while it is easy to think of unemployment as being caused by rigid wages that are too high and – for some reason – cannot be cut (see e.g. the literature on (downward) wage rigidity Knoppik/Beissinger 2009), it is much harder to think of wages as being too rigid upwards. To the best of our knowledge, the literature has not been successful in bringing up arguments for upward wage rigidity.³

As can be seen for example in Shah/Burke (2001); Fox/Comerford (2008), replacement demand in a pure flow equilibrium implies – ignoring employment expansion or decline – that all outflows from an occupation must be replaced by an equal number of inflows. Hence, to obtain such a result in a theoretical setting when the population is ageing and there are more people retiring

³ While it is true that implicit or explicit contracts (see e.g. Malcomson, 1999) might also prevent wages from adjusting upwards, this literature does not yield arguments for a disequilibrium on the labour market, caused by demographic trends. The contracts insure individuals against fluctuations and are not long-term.

than entering the labour-force population, the model would need to imply that neither wages nor labour demand, nor labour supply (in the long run) adapt to the increasing number of outflows.

Labour market imperfections are obviously not an unrealistic assumption. However, even taking this fact into account, from our point of view, there are not many labour-market theories which support a replacement demand argument. One possibility to think of replacement demand is the existence of some kind of sluggish adjustment towards a new equilibrium in reaction to demographic changes. Such adjustment occurs for example, in models of dynamic labour demand, where firms have difficulties in *reducing* their labour due to firing costs (see, e.g. Hamermesh, 1993). With regard to the demographic changes which we analyse here, however, firing costs do not play a key role as the workers are retiring voluntarily. Hence, in our context, if firms are "slow" in adapting to changes in labour demand, but at the same time an increasing number of new workers should be hired because more current workers are retiring, then they would be hiring fewer workers than is optimal. But this is the exact opposite of unfulfilled replacement demand.

Firing costs also play a crucial role in "insider-outsider" models (see Lindbeck/Snowder, 2001). Again: in the case of replacement demand these are not highly relevant. These models also help explain wage rigidities. However, in our context where demographic changes are likely to lead to a reduction of labour demand, equilibrium requires increasing, rather than decreasing wages. Hence, downward wage rigidities are unimportant.

With regard to matching theory, as in the standard neo-classical model, the size of the labour force plays no role for (un-)employment rates in the basic matching model (Pissarides, 2000, Chap. 2) as firms adapt their labour demand (i.e. vacancies) accordingly. A "labour shortage" would result in higher labour-market tightness and hence higher wages and lower labour demand. The approach we choose to demonstrate the effects of population ageing and decreasing population size is based on the matching model in Pissarides (2000, Chap. 4).⁴ We extend the model by explicitly taking different retirement rates from unemployment and employment respectively into account. This is important from our point of view, since, empirically the retirement decision clearly depends on the labour market status of a person. The impact of demographic changes on age-specific employment and unemployment rates has been studied before. Shimer (2001); Skans (2005); Garloff/Pohl/Schanne (2011) attempt to estimate the impact of changes in the population share of the young (age 16 to 24) on unemployment and age-specific employment rates, however, without explicit reference to a theoretical labour-market model.⁵ We fill this research gap by presenting a theoretical model in which we can interpret changes of population and employment variables.

We assume an exogenous job-destruction rate λ . Hence, denoting the total labour force by L and

⁴ Seeing as in the basic empirical setting we focus on how the number of older workers in an occupation are being replaced by younger workers with the same occupation, we abstract from mismatch unemployment as for example in Shimer (2007); Şahin et al. (2012) whereby some occupations are losing employment and dismissed workers need to find new jobs in different occupations.

⁵ In addition, García-Pérez/Jiménez-Martín/Sánchez-Martín (2013) find that the unemployed and employed react very differently to different pension incentives.

the unemployment rate by u , the number of workers who loose their jobs in a given period of time is $\lambda(1 - u)L$. In addition, people are assumed to quit their jobs to look for another job at the (exogenous) rate λ_0 . Further, there is a flow of new entrants bL who first start as unemployed when they enter the labour force.⁶ In the basic model in Pissarides (2000, Chap. 4), the retirement rate d from both unemployment and employment is the same. With an ageing population, this rate is expected to increase in the future as at any given moment in time, a larger proportion of the labour force retires.⁷ In our model, we distinguish the retiring rate out of employment d_e and out of unemployment d_u . The increasing overall exit rate from the labour market to retiring is however thought to show up in both the exit rates out of employment and out of unemployment. The number of workers who find new jobs in the (small) time interval dt is given by $q(\theta)\theta uLdt$ where $\theta = v/u$ is the relationship between vacancies and unemployed and is thus an indicator for labour-market tightness. Hence, labour-market flows are:

$$\frac{d}{dt}uL = (\lambda + \lambda_0)(1 - u)L + bL - duL - q(\theta)\theta uL$$

from which follows, that the steady-state unemployment rate is

$$u = \frac{\lambda + \lambda_0 + b}{\lambda + \lambda_0 + b + q(\theta)\theta} \quad (1)$$

As can be seen from equation (1), only the labour-force entry but not the retirement rate influences steady-state unemployment rate. This result is due to the assumption that the retirement rate is the same both from unemployment as well as employment. Hence, if more people retire, this has an equal influence on both the unemployed and employed and therefore does not influence labour-market tightness.

Relaxing the assumption that the retirement rate out of employment and unemployment are the same and assuming instead that retirements out of unemployment d_u are higher than those whilst working d_e leads to:⁸

$$u = \frac{b + \lambda + d_u - d_e + \theta q(\theta) \pm \sqrt{4(b + \lambda)(d_e - d_u) + (b + \lambda + d_u - d_e + \theta q(\theta))^2}}{2(d_u - d_e)} \quad (2)$$

Taking job-retirement and voluntary quits into account means that the standard job-creation condition from matching theory needs to be slightly modified as follows

$$p - w - \frac{(r + \lambda + \lambda_0 + d_e)pc}{q(\theta)} = 0 \quad (3)$$

⁶ Due to the demographic changes Germany has been experiencing, these have declined in the past and – depending on how much immigration Germany has – are likely to further decline in the future.

⁷ It is important to distinguish between the *individual* retirement probability which could well be decreasing in future as people are expected to remain in the labour force for a longer period of time and the *macroeconomic* retirement rate which is the share of older workers in the labour force. It is this latter rate which we analyse in this paper.

⁸ See the appendix for the derivation.

where r is the interest rate, p denotes productivity and c are the costs of searching that firms incur when posting a vacancy. As can be seen from this equation, the birth rate has no direct influence on job-creation. The reason is that when a firm decides to post a vacancy, this decision depends on the expected duration of the productive match. This depends only on the retirement (from employment) and job-quitting rate but not on the birth rate. However, as the birth rate does affect the unemployment rate (2) and hence labour-market tightness, it has an indirect effect on job creation. *C.p.* a lower (higher) retirement rate from employment will increase (decrease) job-creation because lower (higher) productivity levels are required to make new jobs profitable since, on average, they last longer.

Wages are derived from the Nash bargaining solution that maximises the weighted product of the worker's and the firm's net return from the job match. The present-discounted value of being employed taking the quitting and retiring rates into account is given by

$$rW = w + (\lambda + \lambda_0)(U - W) - d_e W \quad (4)$$

and that of looking for a job is

$$rU = z + \frac{\beta}{1 - \beta} p c \theta - d_u U \quad (5)$$

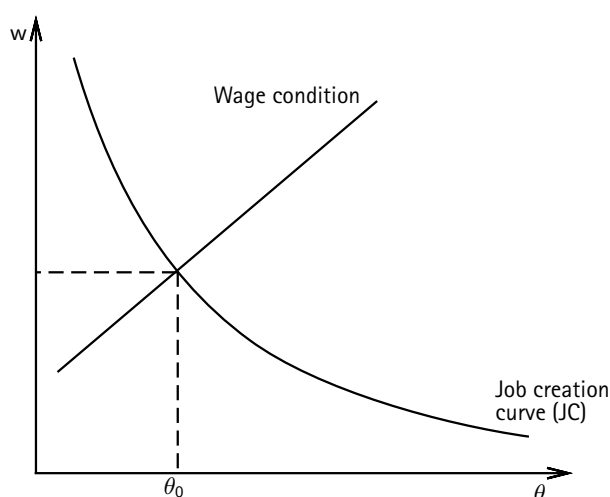
Using these equations and assuming that in equilibrium all profit opportunities are exploited, i.e. the current value of posting a vacancy is zero, leads to a modified wage equation given by:

$$w = \frac{z(1 - \beta)(r + d_e) + p\beta(r + d_u + c\theta(r + d_e))}{r + d_u} \quad (6)$$

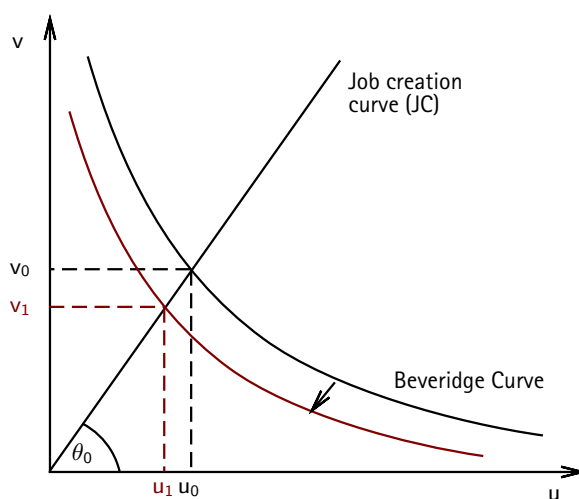
From the above, the steady-state is hence characterised by the Beveridge-Curve (2), the job-creation condition (3) and the wage equation (6). As the focus here is on the influence of a decreasing size of the labour-force population, we graphically analyse both a fall in the rate of people entering the labour force as well as a higher aggregate retirement rate from employment as a larger share of the population reach the retirement age at any given point in time and hence leave the labour market.

Figure 1 shows how a lower labour-force entry rate influences wages and labour-market tightness. From above, it can be seen that this has no influence on the job-creation or wage condition. It only shifts the Beveridge-Curve to the left.

Figure 1: Decrease in the Birth Rate



(a) Wages and Labour-Market Tightness



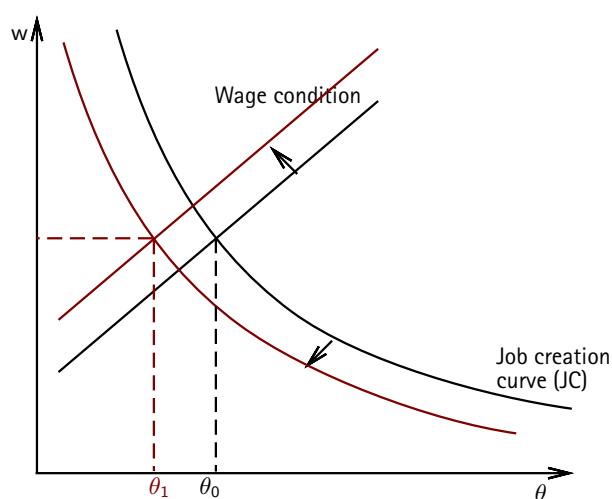
(b) Vacancies and Unemployment

As can be seen from panel (b) in Figure 1, a decrease in the birth rate reduces equilibrium unemployment.

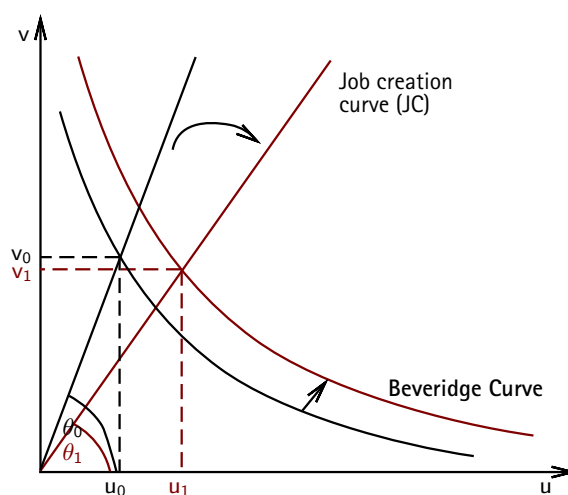
Figure 2 shows the effects of more people retiring from employment. As panel (a) shows, a higher retirement rate reduces labour supply and hence *c.p.* leads to higher wages. At the same time, an increase in the retirement rate shifts the job-creation condition to the left, i.e. decreases θ as firms now offer fewer vacancies which counteracts the wage increase. From panel (b) it can be seen that the lower θ rotates the job-creation condition clockwise. An increase in the retirements (from employment) shifts the Beveridge Curve up because there are now fewer vacancies as these are now less profitable. The net result is higher unemployment. The effect on vacancies is not clear cut.⁹

⁹ Augmenting this model by introducing endogenous job destruction does not alter the qualitative results. Compared to the basic model here this extension has the additional effect that it further lowers labour-market tightness as

Figure 2: Increase in the Retirement Rate (from Employment)



(a) Wages and Labour-Market Tightness



(b) Vacancies and Unemployment

Summarising the theoretical discussion, we find that in the context of a matching model, a lower labour-force entry rate due to declining birth rates reduces unemployment whereas a higher retirement rate from employment increases unemployment. Whereas the first result is in line with the popular "labour-shortage"-argument, the second finding clearly contradicts the statement that unemployment will decrease the more people leave the labour market. In our view this emphasises the fact that the "labour-shortage" and replacement-demand hypothesis are too simple in their argumentation as labour-market adjustments are not adequately accounted for.

labour hoarding becomes less attractive for firms (i.e. jobs are destroyed sooner) because the average job-duration goes down.

Data and Empirical Results

Replacement Demand Across Occupational Groups

From the above we find no theoretical support for the argument that a lower birth and/or higher retirement rate leads to labour shortages. Instead, in the above model unemployment may actually increase due to the assumed demographic changes. In this section we analyse empirically using data from the German Federal Employment Agency (*Bundesagentur für Arbeit*) whether in the past there was a significant relationship between the size of the cohorts leaving a certain market segment and the size of those entering in this market segment. We do this to be able to make the following argument: if there is something like replacement demand and this replacement demand is to be met by youngsters, we would expect in those occupations where many old employees retire many new youngsters appearing.¹⁰ In order to do this, we use aggregated data on employees in West Germany for each two-digit occupation from 1987 – 2011.¹¹ The employees per occupation and year are further differentiated by age, i.e. into groups of 15 – 24 year olds, 25 – 34 years olds etc.. The last age group contains all people aged 65 and over.

The starting point of our empirical analysis is the specification in Freeman (2006). He regresses the share of each occupational age group at time t on the share of this age group ten years before as well as the share of 55 – 64 year olds ten years before. The basic intuition is that – if replacement demand is important – then those who were 55 – 64 ten years ago should mostly be retired ten years later and have been “replaced” by the young age group. Therefore, the share of the young workers should be higher the higher the share of the older workers was ten years earlier. The share of the dependent age group ten years ago is also included as a covariate to take demography-specific effects into account. I.e., it could be that an age group now has a large share because it has always played a dominant role in a certain occupation. The results are shown in Table 1.¹²

As can be seen from the table there is no significant relationship between a high (i.e. above average) share of 55 – 64 year olds ten years before and the share of younger workers in an occupation ten years later. Hence, at least according to this specification, we find no evidence of replacement demand occurring.

One of the main explanations of Freeman (2006) why he finds no evidence for replacement demand is that occupations with high shares of older workers ten years ago were occupations that were “dying out” and hence not attracting many more younger workers. For this reason, we ran the above specifications again once for occupations where total employment increased in our observation period and once for those where it decreased.

¹⁰ There are quite a lot labour market analysis tools that analyse the labour market perspectives of occupational groups from the perspective of the share of older workers leaving this occupational group and the small size of the entry cohorts.

¹¹ The data is based on the number employed on the 30th June in each year.

¹² The coefficients and significance levels are shown in Table A.1 in the appendix.

Table 1: Freeman-Specification

Age group	55 – 64 year olds ten years earlier Share of employees
15 – 24	0
25 – 34	-
35 – 44	+
45 – 54	+

+: positive and significant at the 1 %-level;
 -: negative and significant at the 1 %-level;
 0: not significant at the 10 %-level

Focussing on the results for the 15 – 24 year olds (see Table A.1 for the full results), for growing occupations we now astonishingly find a significant negative relationship with regard to the shares. The result in levels (i.e. number of people in an age group) remains the same. For occupations where the number of employees are decreasing between 1987 and 2011, the coefficient in the share equation remains insignificant.

To further check for the dying out hypothesis of Freeman (2006), we also ran a specification regressing the growth rate of an occupation on the age structure 10 years before. The results show that the growth rate of a job is not significantly correlated with the size of the oldest age group in this occupation. This is also true when distinguishing between growing and shrinking segments.

The results so far are rather mixed. We therefore enhance the analysis of Freeman (2006) to additionally allow for year dummies and also include the age shares of all other age groups 10 years before (excluding those younger than 15 and older than 65 so that the shares do not add up to one). Hence, we allow for a relationship between the size of other cohorts and the respective cohort 10 years later; for example there might be an effect of the parents choice on that of their children. The own age group is again included to allow for aggregate demographic effects and all other effects on the relative cohort size across all occupations. We estimate this model to be able to control for occupation-specific effects on the age structure. This is probably an important extension since it allows occupations to possess a certain age structure. Thus, our estimated equation is the following:

$$\ln(\text{ageshare})_{i,t} = \alpha_0 + \sum_{age} (\alpha_{age} \cdot \ln(\text{ageshare})_{i,t-10}) + \alpha_{occup.} \cdot D_{occup_i} + \alpha_{year} \cdot D_{year_t} + \omega_{i,t}$$

where $\omega_{i,t}$ is the error term for occupation i and time t and assumed to match standard assumptions on the error term (i.i.d.). We now concentrate on the (log of the) shares as the dependent variable. Table 2 gives the sign of the coefficient only for the oldest age group 10 years before; the other results are in A.2 in the appendix.¹³

¹³ For all age groups (besides the youngest) there is obviously a strong positive relationship between the share at

In addition, table 2 also shows the results for several robustness checks: in the second row, we show results for full-time equivalents instead of a head count, which takes account of the fact that replacement demand also could be accommodated by increasing work time. In the third row, we weight the regression with the relative size of the occupation and in the next row we leave out an additional age group in order for the results not to be influenced by near multicollinearity.

Table 2: Extended Freeman-Model. Main Result and Robustness Checks for 15 – 24 year olds

Specification	55 – 64 year olds ten years earlier Coefficient
Basic	0
Full-time equivalents	0
Weighted regression	0
No 35 – 44	+**
15 – 34	+***
Job-Growth-Rate	+*

+***: positive and significant at the 1 %-level;
 +**: positive and significant at the 5 %-level;
 +*: positive and significant at the 10 %-level;
 0: not significant at the 10 %-level

In none of these specifications with the exception of the omitted 35 – 44 year olds do we find a significant relationship between the oldest age group 10 years before and the youngest age group 10 years after. Thus, the occupational choice at the beginning of a career does not seem to be driven by the variable that would proxy for replacement demand. However, it could be that labour shortage may be concentrated on the skilled and high-skilled. Especially for the high-skilled, defining the youngest age group to be at most 24 might be too restrictive as many are still studying at this age and only enter the labour market at a later age. For this reason we performed a regression where we define the youngest age group to be between 15 and under 35. As can be seen from the final row in Table 2 is that now we do find a positive relationship between the share of 55 – 64 year old ten years prior. As shown in Table A.2 – this also holds if we run separate regressions by different qualification levels.

What we also find, however, is that the next two age groups (25 – 34 and 35 – 44) are positively related with the retiring cohort ten years before. At least the positive results for those aged 35 – 44 could be a hint that occupational changes may be important when there is a high replacement demand, i.e. large outflows (because the size of this age group ten years before is controlled in the regression as well). For this reason, in the following, we look at the influence of the age structure in an occupation on the probability of switching occupations more closely.

time t and the share of this age group when they were 10 years younger.

Occupational Changes

We perceive the interpretation, that probably most of the replacement demand – if it is satisfied – is satisfied via occupational changes, as an interesting possible conclusion. To analyse this assertion, in this subsection, we perform an additional analysis which is meant to complement the analysis above. To do this, we use a large administrative dataset for Germany (the SIAB 1975–2008) to analyse occupational changes and its relationship to the variables of demographic change that we are discussing above.

The SIAB covers the time period of 1975 to 2008 and is a 2 percent random sample of all individuals that have been subject to social security employment at least once within this time period. It is a process generated administrative dataset, where part of the information is relevant for payments and thus can be viewed as hard information. It contains information on both employment as well as on unemployment spells. For our purpose we use only the employment information.¹⁴

We use the dataset to analyse occupational changes. To do this, we use the same occupational classification that we employed above and observe transitions between occupations at the individual level. We define a variable that takes on the value 1 every time an individual changes her or his occupation. To explain the likelihood of an occupational change, we run the following probit model, pool it over all observation years and maximise the likelihood of having observed our sample. Using the notation of Wooldridge (2002), we have

$$ProbOC_{ijt} = 1|X = \Phi(X_{it}\beta + Y_{jt}\gamma + AgeS_{jt}\delta) ,$$

where $OC_{ijt} = 1$ if the individual i changes from occupation j to another occupation at time (year) t , X_{it} are control variables for the individual i , Y_{jt} are control variables for the occupation j and the $AgeS_{jt}$ is the age structure in occupation j at time t . As far as the age structure of the occupation is concerned, we are particularly interested in the correlation between the share of older individuals (aged between 55 and 64) and the likelihood of an occupational change.¹⁵ β and γ are the true effects of X and the $AgeS$ on the probability of an occupational change. We assume that the error term of the latent variable (difference in the utility assigned to the potential new job minus the utility of remaining in the old job), determining the occupational change is i.i.d normally distributed with expectation zero and variance σ^2 and Φ is thus the c.d.f. of the normal distribution. X, Y comprises occupation dummies, the growth of the occupation over the last 10 years, the contemporaneous turnover rate in this occupation, the educational attainment of the individual, year dummies, gender, the age, the nationality, the age of the establishment, the relative wage of the individual relative to all others and relative to all others in the same occupation and a few others.

¹⁴ For a more thorough description of the dataset, see Dorner et al. (2010).

¹⁵ We use alternatively both the contemporaneous share of older individuals and, for consistency reasons, the 10 years lag and the cumulated shares over the last 10 years.

The astonishing result is that through almost all specifications¹⁶, we find a significant positive correlation between the share of 55 to 64 years old in an occupation and the likelihood of changing the job. This is contrary to what we expected: from the perspective that individuals change jobs to meet replacement demand, people would change into occupations that have or had previously a high share of older individuals and remain in occupations with a high share of old individuals, given the growth rate of the job.¹⁷

Table 3: Estimation Results: Probit-Regression

Variable	Coefficient	(Std. Err.)
growth_occupation_10yrs	0.005	(0.008)
share_55_64_L10	0.307	(0.098)
int_growth_share_L10	-0.142	(0.059)
female	-0.082	(0.003)
age	-0.003	(0.000)
foreigner	-0.043	(0.004)
relative_wage	-0.114	(0.006)
relative_wage_occupation	0.117	(0.006)
age_establishment	-0.005	(0.000)
size_establishment	0.000	(0.000)
Intercept	-1.312	(0.024)

Further covariates include: education dummies, year Dummies, occupation dummies, dummies for professional status

Conclusion

In this paper, we analyse the replacement-demand argument which predicts a labour shortage based on the observation that many old individuals retire while few young ones enter the labour market both from a theoretical and an empirical point of view. In the theoretical part, we are not able to construct a model which gives rise to replacement demand: it is hard to think about economic mechanisms preventing wages from adjusting upwards and thus to prevent labour demand and supply from adjusting to demographic changes. This shows that theoretically this argument stands on a weak basis.

On the other hand, our empirical results are less clear cut. First, our results for Germany show that occupations which have a higher share of old workers are not those which are dying out

¹⁶ Apart from the specification above, we also ran the regressions as logit models, linear panel models with fixed effects and panel probit models with random effects. We also ran yearly probit regressions. In a robustness check, we also constrained ourselves to "voluntary" occupational changes, defined as occupational changes with an intervening non-employment spell of a maximum of 31 days.

¹⁷ One notable exception is a specification where we restrict the occupational change to persons that are always full-time employed throughout their career. The idea behind is that occupational changes that are linked to a change in the working time status might be linked to other events (e.g., family) and thus explained by different factors. In this specification, both for men and for women, the results for the share of older individuals is insignificant.

as hypothesised by Freeman (2006) for the United States. Hence, we find no evidence that the reason why replacement demand may not be taking place is that there are simply only small total inflows into occupations with many older workers and hence large outflows. We further find that if the replacement demand is taking place, it is not satisfied from the youngest group (15 – 24), but more likely from the next two age groups (25 – 34 and 35 – 44). Thus, we believe occupational changes might play an important role in the adjustment process where the labour market adjusts to demographic changes. However, our results from microdata so far do not support this hypothesis either. The result that people move away from occupations that have a high share of older individuals, given both the growth rate and the turnover rate of the occupation, is stable. If these are the occupations which have particularly high replacement demand rates, then we would be expecting the exit rates from these occupations to be particularly low.

Hence, we find no theoretical and mixed empirical support for the replacement-demand hypothesis. This paper, so far, has no clear-cut conclusion. We interpret this as a warning to a simple equation of the form: many persons retiring and few persons entering the labour market leads to shortages. This holds even less in the context of specific occupational groups.

Appendix

Derivation of the unemployment rate in Equation (2)

$$\dot{L} = bL - d_u uL - d_e(1 - u)L$$

$$\frac{\dot{L}}{L} = b - d_u u - d_e(1 - u)$$

$$\dot{u} = (\lambda + \lambda_0)(1 - u) + b - d_u u - q(\theta)\theta u - u(b - d_u u - d_e(1 - u))$$

which simplifies to (1) if $d_u = d_e$.

Table A.1: Freeman-Specification

55 – 64 year olds ten years earlier	
All Occupations	
Age group	Share of employees
15 – 24	-0.024
25 – 34	-0.057***
35 – 44	0.131***
45 – 54	0.086***
Occupations with positive employment growth rates	
15 – 24	-0.067***
25 – 34	-0.122***
35 – 44	0.195***
45 – 54	0.210***
Occupations with negative employment growth rates	
15 – 24	0.037
25 – 34	-0.009
35 – 44	0.046***
45 – 54	0.018

*** p<0.001, ** p<0.01, * p<0.05

Table A.2: Extended Freeman-Specification

55 – 64 year olds ten years earlier	
Age group	Coefficient and Significance
Basic Specification	
15 – 24	0.019
25 – 34	0.148***
35 – 44	0.080***
45 – 54	-0.057***

Table A.2 continued on next page ...

Table A.2 continued ...

55 – 64 year olds ten years earlier	
Age group	Coefficient and Significance
Full-time equivalents	
15 – 24	0.014
25 – 34	0.127***
35 – 44	0.074***
45 – 54	-0.054***
Weighted regression	
15 – 24	-0.023
25 – 34	0.136***
35 – 44	0.089***
45 – 54	0.034**
15 – 34 year olds	
15 – 34	0.234***
35 – 44	0.120***
45 – 54	-0.127***
Low-Skilled	
15 – 34	0.286***
35 – 44	-0.023
45 – 54	-0.161***
Skilled	
15 – 34	0.153***
35 – 44	0.170***
45 – 54	-0.038***
High-Skilled	
15 – 34	0.064***
35 – 44	0.028**
45 – 54	0.009
No 35 – 44 year olds	
15 – 24	0.120**
25 – 34	0.035
45 – 54	0.060*

Table A.2 continued on next page ...

Table A.2 continued ...

55 – 64 year olds ten years earlier	
Age group	Coefficient and Significance
Job-Growth-Rate	
15 – 24	0.073*
25 – 34	0.034
35 – 44	-0.047*
45 – 54	-0.098***

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

References

- Bloom, David E.; Canning, David; Fink, Gunther (2010): Implications of Population Ageing for Economic Growth. In: *Oxford Review of Economic Policy*, Vol. 26, No. 4, p. 583–612.
- Bloom, David E.; Sousa-Poza, Alfonso (2013): Ageing and Productivity: Introduction. In: *Labour Economics forthcoming*.
- Burda, Michael C.; Hunt, Jennifer (2011): What Explains the German Labor Market Miracle in the Great Recession?. In: *Brookings Papers on Economic Activity*, Vol. Spring 2011, p. 273–319.
- D'Addio, Anna Cristina; Keese, Mark; Whitehouse, Edward (2010): Population ageing and labour markets. In: *Oxford Review of Economic Policy*, Vol. 26, No. 4, p. 613–635.
- Dorner, Matthias; Heining, Jörg; Jacobebbinghaus, Peter; Seth, Stefan (2010): Sample of Integrated Labour Market Biographies (SIAB) 1975–2008. FDZ Methodenreport, 09/2010.
- Fox, Roger; Comerford, Barry (2008): Estimating replacement demand: lessons from Ireland. In: *International Journal of Manpower*, Vol. 29, p. 348–361.
- Freeman, Richard B. (2006): Is a Great Labor Shortage Coming? Replacement Demand in the Global Economy. NBER Working Paper 12541.
- García-Pérez, J. Ignacio; Jiménez-Martín, Sergi; Sánchez-Martín, Alfonso R. (2013): Retirement incentives, individual heterogeneity and labor transitions of employed and unemployed workers. In: *Labour Economics*, Vol. 20, p. 106–120.
- Garloff, Alfred; Pohl, Carsten; Schanne, Norbert (2011): Do small labor market entry cohorts reduce unemployment? IAB Discussion Paper, 18/2011.
- Hamermesh, Daniel S. (1993): *Labor demand*. Princeton and Chichester, U.K.: Princeton University Press.

- Knoppik, Christoph; Beissinger, Thomas (2009): Downward Nominal Wage Rigidity in Europe: An Analysis of European Micro Data from the ECHP 1994–2001. In: *Empirical Economics*, Vol. 36, No. 2, p. 321 – 338.
- Lindbeck, Assar; Snower, Dennis J. (2001): Insiders versus Outsiders. In: *Journal of Economic Perspectives*, Vol. 15, No. 1, p. 165–188.
- Mahlberg, B.; Freund, I.; Cuaresma, J.C.; Prskawetz, A. (2013): Ageing, productivity and wages in Austria. In: *Labour Economics forthcoming*.
- Malcomson, James M. (1999): *Individual Employment Contracts*, chap. 35. Amsterdam; New York and Oxford: Elsevier Science, North-Holland, 1 ed., p. 2291–2372.
- Möller, Joachim (2010): The German labor market response in the world recession * de-mystifying a miracle. In: *Journal for Labour Market Research*, Vol. 42, p. 325–336.
- Pissarides, Christopher A. (2000): *Equilibrium Unemployment Theory*. Cambridge, Massachusetts and London, England: MIT Press, 2 ed..
- Prettner, K.; Bloom, D.E.; Strulik, H. (2013): Declining fertility and economic well-being: do education and health ride to the rescue? In: *Labour Economics forthcoming*.
- Şahin, Ayşegül; Song, Joseph; Topa, Giorgio; Violante, Giovanni L. (2012): Mismatch Unemployment. NBER Working Paper 18265.
- Shah, Chandra; Burke, Gerald (2001): Occupational replacement demand in Australia. In: *International Journal of Manpower*, Vol. 22, p. 648–663.
- Shimer, Robert (2007): Mismatch. In: *American Economic Review*, Vol. 97, No. 4, p. 1074–1101.
- Shimer, Robert (2001): The Impact of Young Workers on the Aggregate Labor Market. In: *The Quarterly Journal of Economics*, Vol. 116, No. 3, p. 969–1007.
- Skans, Oskar Nordström (2005): Age effects in Swedish local labor markets. In: *Economics Letters*, Vol. 86, No. 3, p. 419–426.
- United Nations (2012): *United Nations Probabilistic Population Projections, 2nd Revision* New York.
- Willems, E. J. T. A.; de Grip, A. (1993): Forecasting Replacement Demand by Occupation and Education. In: *International Journal of Forecasting*, Vol. 9, No. 2, p. 173–185.
- Wooldridge, Jeffrey M. (2002): *Econometric analysis of cross section and panel data*. Cambridge, Massachusetts and London, England: MIT Press.
- Zwick, T.; Göbel, C. (2013): Are Personnel Measures Effective in Increasing Productivity of Old Workers? In: *Labour Economics forthcoming*.