Within- and Cross-firm Mobility and Earnings Growth*

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May 12, 2010

Abstract

While it is well established that both promotions within firms and mobility across firms lead to substantial earnings progression, few studies offer an integrated analysis of the effects of these two types of mobility on earnings growth. To do this, we exploit a large Danish panel data set and techniques from the literature on earnings dynamics. Furthermore, linked measures of income taxation – a unique feature of our data – allow us to estimate whether the effects of mobility on gross income growth carry over to net income. We show that vertical mobility, either within or across firms, and not horizontal mobility across firms is what ultimately matters for gross earnings growth. However, because of progressive taxation, we do not see any effects of vertical mobility on net earnings growth. Instead, the fruits of promotions are enjoyed in the form of tax shields such as future consumption via tax deductable pension contributions and more expensive real estate or financed consumption where interest is tax deductable.

*We thank Daniel Hamermesh, Tom Lemieux, Michael Svarer and Rune Vejlin for helpful comments. The authors are grateful to the Danish Social Science Research Council (FSE) for funding.

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1 Introduction

It is well established in the personnel economics literature that promotions on average lead to substantial earnings progression, while demotions – when they occur – tend to depress earnings growth. Virtually all that we know about the effect of promotions (and demotions), however, is based on studies using personnel records from individual firms.[1] While some attempts have been made to broaden our perspective of careers within firms by using multi-firm panels (e.g. Olson and Becker 1983, McCue 1996, Belzil and Bognanno 2008), the cross-firm mobility aspect is typically ignored because the data do not allow researchers to follow individuals when they switch firms.[2]

Interfirm moves, however, appear to play a major role for earnings progression as well. The impact of cross-firm mobility on earnings and earnings growth is the subject of a substantial literature that typically has access to more representative data sources.[3] Topel and Ward (1992), for example, show that wage gains at job changes account for more than one third of the wage growth of young workers in the U.S. There is also a related, emerging literature that structurally estimates job search models with human capital accumulation (e.g. Bunzel *et al.* 2000, Bagger *et al.* 2007, Barlevy 2008, Yamaguchi 2009). These literatures however do not link earnings dynamics to hierarchical career moves, despite the importance that the theoretical and empirical personnel economics literature attaches to them.

However, while it is important to know how labor income depends on within-firm and cross-firm mobility, this is just one side of the story. It provides a "market perspective" on the remuneration of labor. But, because of taxation, market wage rates do not correspond to what an individual actually can spend or save at the end of the day. One might expect that the effect of a progressive tax schedule is simply that pre-tax income growth rates are attenuated. The reasoning is that gains in gross income are taxed at an increasing rate, which means that a higher and higher share of income is eaten up by taxes – thereby dampening the growth of what trickles through in the form of after-tax income.

Alas, it turns out that the effect of taxation is not that simple. Because of deduction opportunities, people can to some extent enjoy the fruits of higher gross income growth by funneling money towards pension savings or taking out mortgages. So what remains of gains in labor income? Is it really the case that mobility allows people to increase the rate at which

[1]For example, Medoff and Abraham 1980, 1981, Lazear 1992, Baker *et al.* 1994a, 1994b, Chiappori *et al.* 1999, Seltzer and Merrett 2000, Hamilton and MacKinnon 2001, Treble *et al.* 2001, Dohmen *et al.* 2004, Gibbs and Hendricks 2004.

[2]Noticeable exceptions are Dias da Silva and Van der Klaauw (2006) and Belzil and Bognanno (2008).

[3]For example, Antel 1986, 1991, Altonji and Shakotko 1987, Bartel and Borjas 1981, Keith and McWilliams 1999, Mincer 1986, Topel 1991, Topel and Ward 1992, Altonji and Williams 2005, Dustmann and Meghir 2005, Buchinsky *et al.* 2009.For cross-country comparisons on the relation between compensation and mobility see Jolivet, Postel-Vinay, and Robin (2006) and Lazear and Shaw (2009).

they consume and save? Or - at the other extreme - are the gains just enough to maintain constant growth in disposable income, by compensating for the higher average tax rate that the individual faces after career progression? Answers to these questions help understand what the true incentives are that people face for investing time and effort toward making career advances.

The contribution of this paper two-fold. First, we bridge the gap between the labor economics literature on cross-firm mobility (that has little to say about the role of hierarchies) and the personnel economics literature on promotions (which has little to say about the role of cross-firm mobility). Our empirical analysis uses registry-based linked employer-employee data from Denmark that allow us to study the impact on earnings growth of horizontal and vertical career moves, both within- and across-firms. We analyze these data by employing econometric techniques that are common in the earnings dynamics literature which pays careful attention to the importance of permanent and transitory shocks for income progression (e.g. Lillard and Willis 1978, Lillard and Weiss 1979, MaCurdy 1982, Abowd and Card 1989, Baker 1997, Meghir and Pistaferri 2004, Browning *et al.* 2006, Altonji *et al.* 2009). Second, our data set has the unique feature that it allows to link gross labor income data to the actual taxes paid as well as several measures of tax deductions. This gives us access to the "employees' perspective" on earnings growth, by estimating directly the effects of mobility on after-tax income.

Finally, while are results are certainly informative of the effects of mobility in Denmark, they also shed some light on mobility in the US and the UK as the Danish labor market shares many of the characteristics found in the UK and US labor markets. In particular, it has highly liberal labor market policies. There is weak job security, and the absence of severance pay legislation as well as lacking experience rating in the unemployment insurance system translate into low costs of laying off workers. The major difference lies in the generosity of unemployment benefits. Overall, barriers to mobility are low and there is substantial job and wage mobility.[4] On the tax side, like many other countries Denmark has a progressive tax schedule. While overall tax rates are quite high by international standards, the tax code has some similarities with the US in that interest payments on mortgages are tax deductible. This feature turns out to be an important element of the relation between gross and net income growth.

The paper is organized as follows. Section 2 describes our data and Section 3 our econometric strategy. Our results on mobility and pre-tax and post-tax labor income growth follow in Section 4 with further robustness checks in Section 5 . Section 6 concludes the paper.

[4]For a detailed discussion of the institutional settings in Denmark see Eriksson and Westergaard-Nielsen (2009). Frederiksen (2008) provides a comparison with the labor markets in the US and the UK.

2 The Data

We use the Integrated Database for Labor Market Research (IDA) from Denmark. In this database, Statistics Denmark collects register-based information on all establishments and residents in Denmark.[5] The IDA data contain individual and establishment identifiers for the entire Danish working population which allows reasearchers to track careers of all employees both within and across firms. In addition to allowing us to identify employer-employee matches, the data also allow us to construct a measure of hierarchical placement. Using the first digit of the (Danish) International Standard Classification of Occupations (DISCO) codes, we can distinguish "managers" (DISCO major group 1, comprising corporate managers and general managers) from "non-managers" (subsuming all other major groups).[6] Consequently, we are able to identify both movement within and across firms which is something that few other studies are able to do.

In this paper, we focus on a set of core employees in private-sector establishments. Our main results are based on a sample that includes all male employees who were continuously in full time employment between 1994 and 2005 in private sector establishments with at least 25 employees, and who were aged between 30 and 45 years at the start of the panel in 1994.[7] With this selection, the age range in the panel is between 30 and 56, so that education and retirement choices play no significant role. Table 1 presents descriptive statistics for the sample. At the start of our panel, the average person is 38 years old, works in a firm with 2,559 employees and has annual labor income (base salary plus bonuses) of DKK 340,367 (in year 2000 prices, corresponding to 28,364 U.S. dollars).

[Table 1 about here]

The flows in this paper are based on comparing the primary employment relationships for each person in November of consecutive years, when employer-employee matches are recorded. Shorter employment periods (and associated flows), for instance lasting from March to September of a particular year, cannot be picked up with these data. This does not seem problematic for our purposes as we focus on core employees with continuous employment histories. Our main sample contains a balanced panel of 58,860 unique individuals, who each have an 11-year employment history, resulting in 706,320 person-year observations.

[Table 2 about here]

[5]The Danish name for the database is *Integreret Database for Arbejdsmarkedsforskning (IDA)*. It is documented on http://www.dst.dk/TilSalg/Forskningsservice/Databaser/IDA.aspx.

[6]The DISCO codes follow the international definitions from the International Labor Organization (ILO), documented on http://www.ilo.org/public/english/bureau/stat/isco/.

[7]Section 5.3 reports results on the corresponding female sample.

Most employees stay where they are in a given year, but a significant fraction of them move across firms (around 11 percent). The combination of cross-firm mobility and within-firm moves results in the eight different types of flows summarized in Table 2. Non-managers make up around 93 percent of all employees. The bulk of them remain non-managers, with 87 percent move horizontally within the firm (HWF) and 11 percent move horizontally across firms (HCF). A bit more than 1 percent are promoted to a management position within the same firm (PWF) and promotions across firms (PCF) account for 0.3 percent. Similarly, managers (who make up around 7 percent of employees) typically stay in management positions, but there is less persistence than for non-managers: 78 percent move horizontally within the firm (ManHWF) and 8 percent across firms (ManHCF). Almost 12 percent of managers are demoted to non-management positions within the firm (DWF) and slightly less than 3 percent move cross-firm to a non-manager position (DCF). While downward moves are not uncommon, overall, promotions (both within- and cross-firm) are about 1.3 times more frequent than demotions.[8]

3 Econometric Strategy

We denote (pre- or post- tax) income as $C_{i,t}$ for individual $i \in \mathcal{I}$ at date $t \in \mathcal{T}$. Log earnings growth is modeled as

$$\Delta \ln (C_{i,t}) \equiv \ln(C_{i,t}) - \ln(C_{i,t-1}) = \alpha_i + \sum_{j=1}^{J} \mu_j \, M_{j,i,t} + X'_{i,t} \, \beta + u_{i,t}. \tag{1}$$

The right-hand side consists of a fixed effect (α_i), J mobility dummies $M_{j,i,t}$ (corresponding to the mobility outcomes HCF, PWF, PCF, $ManHWF$, $ManHCF$, DWF, DCF discussed in Section 2), a vector of control variables ($X'_{i,t}$), and a residual ($u_{i,t}$). Our control variables include a quadratic in age as well as dummies for education, firm-sector and year.

There are three important econometric issues that must be addressed. The first is the covariance structure of the residual. The second is the econometric treatment of mobility. The third is the possibility of a fixed effect in earnings growth.

First, the covariance structure of the residual in specification (1) warrants some attention as it will contain both permanent and transitory components. Accordingly, we will have that

$$u_{i,t} = v_{i,t} + \Delta \varepsilon_{i,t}$$

[8]Our data add to a number of studies which show that demotions are by no means exceptional, including Belzil and Bognanno's (2008) study of US executives (with a promotions/demotions ratio of 1.1 to 5.1, depending on the definition of hierarchical levels), Seltzer and Merrett's (2000) study of the 19th century Union Bank of Australia (ratio 2.1), and Hamilton and MacKinnon (2001) study of Canadian Pacific Railway (ratio 1.7).

where $\upsilon_{i,t}$ is an *iid* permanent income shock and $\varepsilon_{i,t}$ is a transitory shock that follows an MA(q) process. This implies that $u_{i,t}$ will have non-zero autocorrelations up to order $q+1$. Previous work (e.g.Topel and Ward (1992), Abowd and Card (1989) and Meghir and Pistaferri (2004)) suggests that $\varepsilon_{i,t}$ is MA(2). To purge the model of any serial correlation in the residual, we project $\Delta\varepsilon_{i,t}$ onto lagged earnings growth

$$\Delta\varepsilon_{i,t} = \sum_{s=1}^{S} \gamma_s \, \Delta \ln (C_{i,t-s}) + \xi_{i,t}.$$

Substituting, we obtain

$$\Delta \ln (C_{i,t}) = \alpha_i + \sum_{s=1}^{S} \gamma_s \, \Delta \ln (C_{i,t-s}) + \sum_{j=1}^{J} \mu_j \, M_{j,i,t} + X'_{i,t} \, \beta + e_{i,t}. \tag{2}$$

where $e_{i,t} \equiv \xi_{i,t} + \upsilon_{i,t}$. The parameters γ_s reflect the correlation between lagged earnings growth and transitory earnings shocks. We choose S so that $e_{i,t}$ has no serially correlation. In this sense, our specification is consistent with Topel and Ward (1992), Abowd and Card (1989) and Meghir and Pistaferri (2004) where earnings is modeled as an ARMA process with a unit root.

Second, we assume that mobility is predetermined. This yields the moment conditions

$$E \left[e_{i,t} \, M_{j,i,s} \right] = 0 \; for \; t \geq s \; and \; \forall j,$$

These conditions assume that the residual in (2) at time t is orthogonal to all mobility dated t and prior. This implies that the permanent income innovation embedded in $e_{i,t}$ is allowed to affect mobility at $t+1$ and beyond. As discussed in Arellano and Honoré (2001), our predeterminedness assumption restricts the serial correlation in $e_{i,t}$. For this reason, we choose lag length S so that the residuals are serially uncorrelated using the Cochrane-Orcutt test.

Third, our choice of estimation method depends on whether we need to account for a fixed effect in earnings growth or not. In the presence of a fixed effect (i.e. $Var(\alpha_i) > 0$), we need to work with the model in first differences:

$$\Delta\Delta \ln (C_{i,t}) = \sum_{s=1}^{S} \gamma_s \, \Delta\Delta \ln (C_{i,t-s}) + \sum_{j=1}^{J} \mu_j \, \Delta M_{j,i,t} + \Delta X'_{i,t}\beta + \Delta e_{i,t}. \tag{3}$$

In other words, the *double* difference of log earnings then serves as the dependent variable. We can use the level of the mobility variables dated $t-1$ and earlier as instruments for $\Delta M_{j,i,t}$ as in Arellano and Bond (1991). This is the procedure used by Belzil and Bognanno (2008). However, if $Var(\alpha_i) = 0$ then the double difference procedure is not necessary. In this case, we can estimate equation (2) using OLS. Finally, we note that if $Var(\alpha_i) > 0$ earnings growth will have non-zero autocorrelations at arbitrarily long leads and lags. We will test for this later on in the paper. This test will tell us whether we can simply use OLS or if we need to use a more involved GMM procedure.

Finally, it is important to note that the inclusion of lagged earnings growth in equation (2) not only serves the purpose of eliminating serial correlation in $u_{i,t}$, but it also lends itself to a structural interpretation. Particularly, it implies that the premium associated with a given type of mobility that is captured in μ_j will have potentially complicated dynamic consequences on future earnings. If we ignore the $\gamma_s \Delta \ln (C_{i,t-s})$ terms for the moment, matters are straightforward and mobility will behave exactly like a permanent innovation to earnings. However, many theories of hierarchies within firms, such as Lazear (2004), suggest that promotions will in part depend on temporarially high effort. Consequently, productivity may be higher immediately prior to promotion than it is afterwards. If bonus pay (which is a component of $C_{i,t}$ in our data) reflects this, then there will be some degree of mean reversion in the process. This would be captured by negative coefficients on lagged earnings growth in equation (2). Thus, this implies that it is incorrect to assume that the premium embedded in μ_j will behave exactly like a permanent innovation to earnings. We will take this into consideration when computing the dynamic consequences of mobility later on in this work.

4 Mobility and Labor Income Growth

4.1 Specification Tests

As discussed above, our choice of a GMM procedure *a la* Arellano and Bond (1991) versus OLS depends on whether or not $Var(\alpha_i) > 0$. To test this, we employ a common procedure in the earnings dynamics literature (e.g. Abowd and Card (1989), Meghir and Pistaferri (2004) and Topel and Ward (1992)) in which we compute autocorrelations of earnings growth. In the presence of a fixed effect in earnings growth, these should be positive and significant at all leads and lags. The autocovariances along with their bootstrapped standard errors are reported in Table 4.

That fact that we only see significant autocorrelations up to order 2 has two implications First, it suggests that there is no fixed effect in earnings growth and, thus, OLS should be adequate. However, to explore the robustness of our findings, in Section ??, we report GMM estimates of specification (3). Second, it suggests that the transitory earnings shocks are MA(1).

[Table 3 about here]

Finally, we address an important issue raised by Baker (1997) who points out that the test for the absence of a fixed effect in earnings growth in Table 4 can have low power. He shows that this is the case in his extract from the Panel Study of Income Dynamics which has approximately 500 individuals. However, we do not believe that this is an issue in our

sample as we have over 58,000 individuals. Another potential issue is that, in studies with unbalanced panels, the higher order covariances are estimated with less data than at lower orders. This results in a failure to reject the null of a zero autocovariance at higher orders. However, this is not an issue in our study as we have a balanced panel.

4.2 Estimation Results: Gross Income

4.2.1 Ignoring Transitory Shocks

[Table 4 about here]

We begin by estimating the model in equation (1) using OLS. Note that this model is not properly specified as it does not include lagged earnings growth and so does not properly account for the covariance structure of earnings growth. Our reasons for doing this are twofold. First, we do so as a matter of data description. Second, conducting this exercise allows us to better understand the role that transitory shocks play in the relationship between mobility and earnings progression.

Results are reported in Table 3. First, we see that moving to a new employer is associated with about 1 percent higher labor income growth. Next, looking at hierarchical transitions, we see that an upward move accelerates earnings growth by about 1.4 percent, whereas a downward move has no significant effect. However, distinguishing between within- and cross-firm moves, we obtain a more differentiated picture. A non-manager moving to a position in a new firm gains 0.9 percent if he stays at the same level. A within-firm promotion to manager yields roughly the same, whereas a cross-firm upward move yields 4.8 percent higher growth. We see that managers are on a steeper earnings profile than non-managers; their labor income increases 0.6 percent faster than for non-managers who make horizontal moves. Cross-firm mobility also pays off more for managers, yielding around 3 percent higher growth than for the non-manager firm-stayers. Finally, demotions put managers back to the earnings growth of a non-manager. In other words, there is no additional penalty on earnings growth.

The first impression thus is that horizontal cross-firm mobility counts roughly as much as a within-firm promotion, and that moving to a new firm tends to enhance the returns to vertical mobility. As in Belzil and Bognanno (2008) we find an asymmetric effect of promotions and demotions: you gain more from moving up to a management position (0.9 percent for PWF, 4.9 percent for PCF) than you lose when you step down from a management position (about 0.7 percent for DWF/0.6 percent for DCF relative to continuing to be a manager in the same firm).

However, while these estimates are interesting as a first-pass, they are biased as they fail to properly account for transitory earnings shocks. To understand this bias, we project the

change in the transitory earnings shock onto the vector of mobility dummies

$$\Delta\varepsilon_{i,t} = \sum_{j=1}^{J} \theta_j \, M_{j,i,t} + \omega_{i,t}.$$

If we employ the decomposition $u_{i,t} = \upsilon_{i,t} + \Delta\varepsilon_{i,t}$ and substitute into equation (1), we obtain

$$\Delta \ln (C_{i,t}) = \alpha_i + \sum_{j=1}^{J} (\mu_j + \theta_j) \, M_{j,i,t} + X'_{i,t} \, \beta + \upsilon_{i,t} + \omega_{i,t}.$$

So, the results in Table 3 are estimates of the $\mu_j + \theta_j$'s and not of the μ_j's and, consequently, the bias is given by θ_j which is the coefficient of a regression of the change in the transitory shocks onto the set of mobility dummies. Theories such as Lazear (2004) suggests that $\theta_j < 0$ for the cases of PWF and PCF since productivity will be temporarially high prior to promotion and, hence, the temproary component of earnings should decline somewhat upon promotion.

4.2.2 Accounting for Transitory Shocks

[Table 5 about here]

In Table 5, we report our estimates of the model in equation (2) which account for transitory shocks to earnings. According to the Cochrane-Orcutt test, one lag of the dependent variable is required to eliminate autocorrelation in the errors. This is exactly in line with our results on autocovariances in Table 3. However, our preferred specification in column (4) includes three lags. We do so for two reasons. First, some of the income measures we look at in the second part of the paper require this lag length. Second, if the Cochrane-Orcutt test has low power, it will select a specification with too few lags of earnings growth. We use this specification to compute the dynamic effects of mobility.

We see that lagged compensation growth has a negative effect on current compensation growth. This negative serial correlation in earnings growth is a fairly ubiquitous result and can found in both the literatures on income dynamics (e.g. Abowd and Card (1989), Meghir and Pistaferri (2004) and Topel and Ward (1992)) and personnel economics (see Belzil and Bognanno's (2008) estimates from a panel of executives in large U.S. firms.) Like us, these papers use an income measure that includes base wage and variable components. As suggested by (e.g. Lazear 2004), these negative coefficients may reflect the effects of transitory shocks; if high income growth yesterday reflects the impact of a transitory shock then there will be a tendency for the transitory components of earnings growth to be lower today.

The most striking change of specification (4) relative to our earlier basic specification (1) is that upward mobility has a much higher return relative to cross-firm mobility. While the growth premium for a non-manager firm switcher remains the same, the coefficient

on within-firm promotions doubles and is about one-third larger for cross-firm promotions. This is consistent with our explanation in the previous subsection that failure to account for transitory shocks will bias estimates of the coeficients on vertical mobility downward. Indeed, we see that the coefficients on PWF and PCF increase substantially each time we add an additional lag of earnings growth. This also suggests that the Cochrane-Orcutt test may have underfit the model.

In addition, the growth premium for being a manager is higher. We see that a manager staying in the same firm has about 1.3 percent higher earnings growth than a non-manager stayer; cross-firm movers at management level see around 3.3 percent higher growth than those at non-management level.[9] This is in line with learning models as Gibbons and Waldman (1999, 2006), where assignment to a higher-level job entails a steeper earnings growth path.

Demotions, on the other hand, still yield no significantly different growth than the baseline of staying a manager within the same firm. As discussed earlier, this reveals an asymmetry between the effect of a promotion and a demotion on wage growth. This is a point that has received little attention, with the exception of Belzil and Bognanno (2008).

[Table 6 about here]

To gauge the absolute effect of mobility on labor income growth after different employment histories, one needs to account for the fact that part of the mobility premiums embedded in our estimates will reflect transitory earnings shocks. In other words, the mobility coefficient estimates will not behave entirely like a permanent earnings innovation. The coefficients on lagged income growth tell us what portion of these mobility premiums eventually disappear.

For this purpose, in Table 6, we compute the dynamic effects over a five year period of four different "treatments." In all cases, we consider a university graduate (edu=17) starting his career at age 30. The first "treatment" is being promoted and never switching

[9]The log growth increment for a non-manager from a cross-firm move in t is

$$\ln\left(\frac{\frac{LI_t}{LI_{t-1}}^{HCF_t}}{\frac{LI_t}{LI_{t-1}}^{HWF_t}}\right) = \ln\left(\frac{LI_t}{LI_{t-1}}^{HCF_t}\right) - \ln\left(\frac{LI_t}{LI_{t-1}}^{HWF_t}\right) = 0.008.$$

That for a manager moving cross-firm in t is

$$\ln\left(\frac{\frac{LI_t}{LI_{t-1}}^{ManHCF_t}}{\frac{LI_t}{LI_{t-1}}^{HWF_t}}\right) = \ln\left(\frac{LI_t}{LI_{t-1}}^{ManHCF_t}\right) - \ln\left(\frac{LI_t}{LI_{t-1}}^{HWF_t}\right) = 0.041.$$

Hence,

$$\ln\left(\frac{\frac{LI_t}{LI_{t-1}}^{ManHCF_t}}{\frac{LI_t}{LI_{t-1}}^{HCF_t}}\right) = 0.041 - 0.008 = 0.033.$$

firms. The second is switching firms after three years, but never being promoted. The third is switching firms and being promoted after three years. The fourth is being promoted after three years and switching firms after five years. In all four cases, the baseline is never switching firms and never being promoted for the enitre period. In each case, we compute earnings over the five year period in the "treatment" and then we compare it to the reference group. Finally, for each of these "treatment effects," we compute the bootstrapped standard errors.

The table reveals the following results. First, it shows that those who switched firms after the third year are basically on the same growth path as a non-manager who never made a move. In contrast, managers (promoted after year three) staying with the firm or switching to a new firm after the fifth year, see higher earnings growth (the difference being both statistically and economically significant).

To illustrate this, Figure 1 plots the evolution of real labor income implied by the estimates for a university graduate (edu=17) starting his career at age 30. The most striking feature is that earnings outcomes after 11 years split neatly into the two categories "never promoted " and "promoted". Cross-firm mobility has a secondary effect only. It plays almost no role for non-manager income in the longer run but does offer some gains for managers. Overall, our results suggest that vertical moves are most important for earnings growth and that cross-firm moves play a significant role only for raising earnings in the long-run once a person has reached the management level.

[Figure 1 about here]

4.3 Mobility and Net Income

The picture that emerges thus far is that real earnings growth seems to be driven by whether or not a person advances in the job hierarchy, and only to a lesser extent by cross-firm mobility. It is important to note however, that this perspective is a rather special one. Our findings are based on labor income data (as are those in all the studies on within-firm or cross-firm individual-level earnings dynamics that we are aware of). So they tell us something about the evolution of real "market wages". What matters for the individual however is not gross income, but rather what is left of it after taxation. If, for example, large parts of gross income gains are taxed away then the estimated effects of mobility on gross income growth would overstate the true incentives for mobility that an individual perceives.

4.3.1 Taxation, Deductions and Net Earnings

The purpose of this section is to examine whether the effects of mobility on gross earnings carry over to after-tax income. At first glance, one might expect that a progressive tax system simply attenuates net income growth relative to gross income growth. To see this

more formally, note that net income (gross income minus taxes paid) can be written a gross income times the individual's average tax rate τ: $C_t^{net} = C_t\,(1-\tau_t)$. With a progressive tax schedule, the average tax rate grows as gross income C_t increases. Hence, net income growth is related to gross income growth as follows (assuming that the tax system has no deductions or exemptions):

$$\frac{C_t^{net}}{C_{t-1}^{net}} = \frac{C_t}{C_{t-1}}\,\frac{(1-\tau_t)}{(1-\tau_{t-1})}.$$

As marginal tax rates increase with gross income, the average tax rate rises and the second factor will be less than one. Therefore, net income grows slower than gross income.

The argument however only captures partially the influence of taxes on income growth. Because the tax system allows for deductions, there is a second effect: deductions from gross income lead to a lower taxable base, so growth in income may look larger relative to the taxable base than it does relative to gross income. In other words, a large increase in deductions may push the net income growth rate above that for gross income. To see the driving forces more clearly, suppose the individual deductions in year t are $C_t\,d_t$. Taxes then are computed as $C_t\,(1-d_t)\,\tau_t$. Hence,

$$\frac{C_t^{net}}{C_{t-1}^{net}} = \frac{C_t}{C_{t-1}}\,\frac{(1-(1-d_t)\,\tau_t)}{(1-(1-d_{t-1})\,\tau_{t-1})}.$$

So net income growth depends not only on the evolution of the average tax rate but also on the rate at which deductions change. Rearranging, we obtain

$$\frac{C_t^{net}}{C_{t-1}^{net}} > \frac{C_t}{C_{t-1}} \quad \Leftrightarrow \quad \frac{1-d_{t-1}}{1-d_t} > \frac{\tau_t}{\tau_{t-1}}.$$

Roughly, net income will grow faster than gross income if there is a large increase in the portion of earnings that are deducted from tax purposes and this outweighs the effect of the progressive tax schedule. Additional details in the tax code add to the two main effects described above of a progressive tax schedule and changing rates of deductions. The bottom line is that there is no simple relation between gross and net income growth.

Our data set has the unique feature that it allows to link gross labor income data to the actual taxes paid as well as an individuals capital income and several measures of tax deductions. So, we can directly estimate the effects of mobility for alternative income measures in an analogous fashion to Section 4. These results are informative about the "employees' perspective" on earnings growth. That is, how gross income growth translates into growth in disposable income, and how through the channel of tax deductions parts of gross income growth goes towards real estate purchases and (financed) durable consumption where interest payments are deductable, or towards future consumption in the form of deductable pension contributions.

4.3.2 Estimation Results: Net Income

[Table 7 about here]

Table 7 reports results on after-tax income and tax-related income measures. In the following we restrict ourselves to a short summary of the main features in the Danish tax code relevant for interpreting the results (Appendix A provides more details). Labor income is subject to a progressive tax schedule with essentially four tax brackets (as illustrated in Figure 10 in Appendix A).

[Figure 10 about here]

There are three income measures that are important for the tax calculation: *labor income, personal income* and *taxable income.* In the year 2000 labor income was taxed with a gross wage of 8 percent and an involuntary pension contribution of 1 percent. Personal income is labor income subtracted the 8+1 percent and *voluntary contributions to pension funds*. Taxable income is personal income plus *capital income* (which for most people is a negative amount) minus relatively minor deductions that follow from comuting costs, unemployment fund membership fees etc. These three measures are the main components for the determination of tax payments. Thus, if the rate at which an individual contributes to pension funds is changed, it will result in a discrepancy in the growth rates of labor income and personal income and if interest payments on debt grow at a different speed than labor income, this will be reflected in differential growth rates for taxable income and labor income. Finally, our measure of the after-tax disposable income, *net income*, adds labor and capital income and subtracts taxes. Any discrepancy in growth rates between labor income and net income reflects the compounded effects of the aforementioned deductions and the progressivity of the tax schedule.

Comparing the first and the last columns of Table 7, we see that the mobility effects cease to be significant after taxes. Figures 2 and 3 illustrate the results by tracing the relative gross and net earnings growth implied by the regression coefficients for a university-educated individual starting his career at age 30. The first impression is that gross and net earnings growth are relatively similar – despite the progressive tax schedule. The effects of mobility, on the other hand, tend to disappear. What this suggests is that individuals adjust the pattern of deductions to maintain a more or less constant after-tax income growth. Extra gains in growth due to mobility appear to go into tax-shielded pension contributions (that is, higher future income) or into adjustments the size of their debt (taking out mortgages to renovate, to enjoy a more expensive home, to purchase additional real estate such as a summer cottage – all very common in Denmark or to finance for instance car loans).

[Figure 2 about here]
[Figure 3 about here]

The results on the tax-related measures are in line with this picture. The mobility effects for *personal income* (second column in Table 7) increase relative to those for labor

income, suggesting that people increase their pension contributions at a faster pace than their gross income grows. Similarly, the results for *taxable income* (third column) are in line with growth in mortgage debt that leads to higher interest payments. Table 6 shows the effects on growth after five years for different mobility scenarios. Again, mobility effects are enhanced for *personal income* and *taxable income*, and they seem to counterbalance the growth attenuating effect of the progressive tax schedule as mobility effects disappear for *net income*.

Overall, our results lead to a remarkable conclusion. Moving up to a management position, and to a lesser extent cross-firm mobility, increase real income growth before taxes. One could have expected these effects to show up in net income as well, just attenuated on account of the progressivity of the tax schedule. However, it seems that people adjust their pension contributions and personal debt to maintain a relatively constant growth in real disposable income. In other words, the incentives for mobility do not seem to be that people want to push up the rate at which they can spend for immediate consumption or or put money into after-tax savings. Rather, extra growth seems to flow into tax-shielded long-term savings (via pension contributions) and mortgage payments. In other words, because of the way the tax system works, the attraction of career progression seems to be that it allows people to enjoy living in nicer, more expensive homes or to have a summer cottage, and that they can look forward to higher income in old age.

5 Robustness Checks

5.1 Estimations on subsamples with varying education

Our main results control for differences in education with dummies that distinguish four categories:

- 9 years, corresponding to less than high school (omitted category, 18.26 percent of the sample)
- 12 years, corresponding to high school degree (56.19 percent of the sample)
- 15 years, corresponding to college or post-secondary professional training (18.55 percent of the sample)
- 17 years, corresponding to a university degree (7.00 percent of the sample).

Table 8 reports estimation results based on subsamples where all individuals fall into the same education category. Figures 4 to 7 illustrate the different estimation outcomes by plotting the gains in real labor income implied by the estimates for a person starting his career at age 30. While earnings growth is less steep for lower education levels, the relative

impact of mobility seems similar. In particular, we obtain the same conclusion as from our main regression. For all education levels we see that earnings outcomes after 11 years can be grouped into the two categories "never promoted " and "promoted". Again, cross-firm mobility plays only a minor role.

[Table 8 about here]
[Figure 4 about here]
[Figure 5 about here]
[Figure 6 about here]
[Figure 7 about here]

5.2 Allowing for a fixed effect in earnings growth

Our main estimates assume that there is no individual-level trend in earnings growth. The fact that autocorrelation in income growth becomes insignificant after a few lags (see Table 3) is indeed at odds with such a fixed effect in earnings growth.

To explore the robustness of our findings, we nevertheless relax this assumption here and allow for unobserved persistent individual heterogeneity in earnings growth. Table 9 reports the corresponding GMM estimates.Consistency of the Arellano-Bond estimator requires residuals (in first differences) to be serially uncorrelated from the second lag on. This is the case with at least two lagged dependent variables as regressors, as the test for autocorrelation developed by Arellano and Bond (1991) shows for the reported specifications.

To illustrate our regression results, Figure 8 plots the evolution of real labor income implied by the estimates for a university graduate (edu=17) starting his career at age 30. It thus compares with Figure 1 for our preferred specification. As we can see, we reach the same conclusion as before, that the evolution of earnings depends mostly on whether a person manages to move up in the hierarchy and less on cross-firm mobility. If at all, the divide between the two categories "never promoted " and "promoted" becomes larger.

[Table 9 about here]
[Figure 8 about here]

5.3 Intra- and inter-firm mobility and earnings growth for women

- Descriptive statistics for female sample: Table 10.
- Mobility patterns for female sample: Table 11.
- Estimates for mobility and income growth, for female sample: Table 12.
- Illustration of effects of mobility on real labor income growth for men versus women: Figure 9.

[Table 10 about here]
[Table 11 about here]
[Table 12 about here]
[Figure 9 about here]

6 Conclusion

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Appendix

A A primer on income taxation in Denmark

All wage income is subject to a gross tax (8 percent in 2000), which is comparable to the social security contributions known in other countries. An additional 1 percent of labor income is paid into a pension fund. Personal income is defined as labor income minus the 8+1 percent of labor income paid in gross tax and pension contribution with the further deduction of voluntary contributions to private pension funds (up to a maximum threshold).

Taxable income is defined as personal income plus capital income minus deductions (lignings mssige fradrag), among which the principal ones are commuting costs, union membership fees and contributions to an unemployment insurance fund. Capital income includes mainly interest earned on savings or interest paid on debt (dividends and capital gains on stocks and bonds are taxed separately). In other words, large amounts of debt (for example, from mortgages) reduce taxable income.

Taxable and personal incomes serve as bases for three different taxes. First, any amount of positive taxable income subtracted a standard allowance called "personal deduction" (DKK 33,400 in 2000) is subject to the municipal and regional taxes (ranging from 26.9 percent to 32.1 percent in 2000) as well as a church tax (average rate is 0.7 percent in 2000) for members of the Danish National Evangelical Lutheran Church (Folkekirken), which applies to around 83 percent of the Danish population. Same base added half of any negative capital income is subject to the bottom-bracket-tax (7 percent in 2000).

Further, any amount of personal income added positive capital income which exceeds a certain threshold (DKK 164,300 in 2000) is subject to the middle-bracket-tax (6 percent in 2000). Finally, the base for the top-bracket-tax is personal income plus voluntary contributions to pension funds and positive capital income. That is, if the base for the top-tax exceeds a certain threshold (DKK 267,600 in 2000) it is taxed at the top-tax rate (15 percent in 2000).

There are two important wrinkles to the Danish tax system. First, if the municipality and regional tax rates are sufficiently high such that they together with the sum of the bottom-, middle- and top-tax rates exceed the tax ceiling (59 percent in 2000) the top tax is reduced such that the sum of these taxes is 59 percent. In practice this implies that the top-tax in almost half the municipalities is below 15 percent and in some at a level around 13.5 percent. Second, if deductions are unused then they can be transfered to a spouse. So, even though the Danish tax system is primarily characterized as an individualized tax system there is a very moderate component of joint taxation embeded in the system.

As a result of the above tax schedule, there are essentially four tax brackets. In Figure 10 we plot the tax schedule for 2000, making it directly comparable with our real income measure that uses 2000 as base year. The schedule assumes that the person lives in a municipality with "average" tax rates, and that the individual has no positive or negative capital income, and no deductions. In other years the income thresholds are adjusted annually to account for inflation and tax rates may be altered slightly over the years.

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Tables and Figures

Table 1: Descriptive statistics (at start of panel in 1994)

Age[a]	37.63
	(4.53)
9 years (less than high school)	18.26%
12 years (high school)	56.19%
15 years (college or post-secondary professional training)	18.55%
17 years (university degree)	7.00%
Real labor income[a,b]	340,367
	(118,874)
Firm size[a] (number of employees, employee weighted average)	2,259
	(3,524)
Average proportion of employees working as managers	5.92%
Unique individuals	58,860
Person-year observations (1994 - 2005)	706,320

Notes: Panel of men aged 30 to 45 in 1994, continuously employed between 1994 and 2005 in private firms with at least 25 employees. [a] Mean (standard deviation).
[b] Year-2000 Danish Kroner (DKK). DKK 100 = 12 U.S. dollars (in year 2000).

Table 2: Mobility patterns

	percent	**percent of group** (annual transition probability)
All transitions	**100**	
Within-firm moves		88.56
Cross-firm moves		11.44
Non-management	**92.73**	**100**
$\boldsymbol{Non\text{-}management_{t-1} \rightarrow Non\text{-}management_t}$		
horizontal move, within-firm (HWF)	80.94	87.28
horizontal move, cross-firm (HCF)	10.43	11.25
$\boldsymbol{Non\text{-}management_{t-1} \rightarrow Management_t}$		
$\boldsymbol{Non\text{-}management_{t-1} \rightarrow Management_t}$		
promotion, within-firm (PWF)	1.12	1.20
promotion, cross-firm (PCF)	0.25	0.27
Management	**7.27**	**100**
$\boldsymbol{Management_{t-1} \rightarrow Management_t}$		
horizontal move, within-firm (ManHWF)	5.65	77.72
horizontal move, cross-firm (ManHCF)	0.56	7.72
$\boldsymbol{Management_{t-1} \rightarrow Non\text{-}management_t}$		
demotion, within-firm (DWF)	0.86	11.78
demotion, cross-firm (DCF)	0.20	2.78

Notes: 647,460 person-year observations 1995-2005 (58,860 unique individuals).

Table 3: The autocovariances of income growth

	Autocovariance (std. error)				
Order	0	1	2	3	4
	0.01892	**-0.00575**	**-0.00117**	0.00001	-0.00004
	(0.00217)	(0.00108)	(0.00048)	(0.00010)	(0.00008)

Notes: **Bold** indicates significance at the 1-percent level (bootstrapped standard errors).

Table 4: Labor income growth and career mobility (exogenous intra- and inter-firm mobility)

	(1)	**(2)**	**(3)**
Cross-firm move	**0.010**		
	(0.001)		
Upward move		**0.014**	
(PWF or PCF)		(0.002)	
Downward move		-0.003	
(DWF or DCF)		(0.003)	
Non-manager horizontal move, within-firm	–	–	–
(HWF)			
Non-manager horizontal move, cross-firm			**0.009**
(HCF)			(0.001)
Promotion, within-firm (PWF)			**0.008**
			(0.002)
Promotion, cross-firm (PCF)			**0.049**
			(0.006)
Manager horizontal move, within-firm			**0.006**
(ManHWF)			(0.001)
Manager horizontal move, cross-firm			**0.033**
(ManHCF)			(0.003)
Demotion, within-firm (DWF)			-0.001
			(0.003)
Demotion, cross-firm (DCF)			-0.000
			(0.007)
Age/10	**-0.033**	**-0.034**	**-0.034**
	(0.003)	(0.003)	(0.003)
$Age^2/100$	**0.002**	**0.002**	**0.002**
	(0.000)	(0.000)	(0.000)
constant	**0.114**	**0.117**	**0.118**
	(0.007)	(0.007)	(0.007)
R^2	0.0069	0.0065	0.0074
Observations	647,460	647,460	647,460

Dependent variable: Change in real log labor income $ln(LI_t) - ln(LI_{t-1})$.

Notes: All regressions include education, sector, and year dummies. **Bold** indicates significance at the 1-percent level. Clustered standard errors are reported in parentheses.

Table 5: Labor income growth and career mobility (OLS)

	(1)	**(2)**	**(3)**	**(4)**
Labor income growth (t-1)		**-0.315**	**-0.388**	**-0.4**
		(0.018)	(0.024)	(0.028)
Labor income growth (t-2)			**-0.204**	**-0.249**
			(0.024)	(0.029)
Labor income growth (t-3)				**-0.105**
				(0.014)
Non-manager horizontal move, within-firm (HWF)	–	–	–	–
Non-manager horizontal move, cross-firm	**0.009**	**0.009**	**0.009**	**0.008**
(HCF)	(0.001)	(0.001)	(0.001)	(0.001)
Promotion, within-firm (PWF)	**0.008**	**0.012**	**0.016**	**0.017**
	(0.002)	(0.002)	(0.002)	(0.002)
Promotion, cross-firm (PCF)	**0.049**	**0.057**	**0.063**	**0.066**
	(0.006)	(0.006)	(0.007)	(0.007)
Manager horizontal move, within-firm	**0.006**	**0.009**	**0.011**	**0.013**
(ManHWF)	(0.001)	(0.001)	(0.001)	(0.001)
Manager horizontal move, cross-firm	**0.033**	**0.038**	**0.04**	**0.041**
(ManHCF)	(0.003)	(0.003)	(0.003)	(0.003)
Demotion, within-firm (DWF)	-0.001	-0.001	0.002	0.007
	(0.003)	(0.003)	(0.003)	(0.008)
Demotion, cross-firm (DCF)	0.000	0.002	0.007	0.006
	(0.007)	(0.007)	(0.008)	(0.008)
Age/10	-0.034	-0.043	**-0.056**	**-0.065**
	(0.003)	(0.004)	(0.0006)	(0.007)
$Age^2/100$	**0.002**	**0.003**	**0.004**	**0.005**
	(0.000)	(0.000)	(0.001)	(0.001)
constant	**0.118**	**0.148**	**0.192**	**0.224**
	(0.007)	(0.009)	(0.013)	(0.017)
R^2	0.0074	0.1014	0.1381	0.1441
Observations	647,460	588,600	529,740	470,880
Cochran-Orcutt (*H_0: zero autocorrelation in errors*)				
	-0.313	-0.067	-0.013	-0.004
(p-value)	(0.000)	(0.126)	(0.759)	(0.933)

Dependent variable: Change in real log labor income $ln(LI_t) - ln(LI_{t-1})$.

Notes: All regressions include education, sector, and year dummies. **Bold** indicates significance at the 1-percent level. Clustered standard errors are reported in parentheses.

Notes: Evolution of real labor income implied by specification (4) in Table 5 for a university graduate (edu=17) starting his career at age 30.

Figure 1: Illustration of real labor income growth.

Table 6: Effect of mobility on income growth after 5 years (OLS, three lags)

Mobility pattern	Labor income	Personal income	Taxable income	Net income
Reference group: never switches firm, never promoted				
Promoted after 3 years,	**0.006**	**0.008**	**0.010**	*0.003*
never switches firm	(0.001)	(0.001)	(0.001)	(0.002)
Switches firm after 3 years,	**-0.001**	0.000	0.000	0.000
never promoted	(0.000)	(0.000)	(0.000)	(0.000)
Switches firm and	0.002	**0.009**	**0.011**	*0.003*
promoted after 3 years	(0.002)	(0.001)	(0.001)	(0.002)
Promoted after 3 years, switches firm	**0.034**	**0.044**	**0.045**	*-0.035*
after 5 years (staying manager)	(0.003)	(0.006)	(0.008)	(0.018)

Notes: log increment over reference group (bootstrapped standard error).

Predictions based on OLS, three lags. Assumes starting age of 30 and edu=17.

Bold (*italics*) denotes significant difference at the 1-percent (5-percent) level.

Table 7: Growth of tax-related components of income (OLS, three lags)

	Labor income	**Personal income**	**Taxable income**	**Net income**
Labor income growth (t-1)	**-0.4**	**-0.597**	**-0.554**	**-0.583**
	(0.028)	(0.018)	(0.015)	(0.016)
Labor income growth (t-2)	**-0.249**	**-0.347**	**-0.302**	**-0.352**
	(0.029)	(0.016)	(0.013)	(0.015)
Labor income growth (t-3)	**-0.105**	**-0.174**	**-0.144**	**-0.184**
	(0.014)	(0.009)	(0.008)	(0.011)
Non-manager horizontal move, within-firm (HWF)	–	–	–	–
Non-manager horizontal move, cross-firm (HCF)	**0.008**	**0.013**	**0.015**	-0.011
	(0.001)	(0.002)	(0.002)	(0.002)
Promotion, within-firm (PWF)	**0.017**	**0.02**	**0.023**	0.007
	(0.002)	(0.005)	(0.007)	(0.010)
Promotion, cross-firm (PCF)	**0.066**	**0.084**	**0.099**	-0.017
	(0.007)	(0.015)	(0.016)	(0.037)
Manager horizontal move, within-firm (ManHWF)	**0.013**	**0.019**	**0.022**	*0.007*
	(0.001)	(0.002)	(0.002)	(0.004)
Manager horizontal move, cross-firm (ManHCF)	**0.041**	**0.056**	**0.057**	-0.029
	(0.003)	(0.006)	(0.008)	(0.020)
Demotion, within-firm (DWF)	0.007	**0.013**	*0.014*	0.012
	(0.008)	(0.005)	(0.007)	(0.012)
Demotion, cross-firm (DCF)	0.006	*0.025*	0.02	-0.046
	(0.008)	(0.010)	(0.012)	(0.038)
Age/10	**-0.065**	**-0.057**	0.004	-0.026
	(0.007)	(0.014)	(0.016)	(0.020)
$Age^2/100$	**0.005**	*0.003*	-0.003	0.000
	(0.001)	(0.002)	(0.002)	(0.002)
constant	**0.224**	**0.207**	*0.089*	*0.177*
	(0.017)	(0.033)	(0.037)	(0.043)
R^2	0.1441	0.3066	0.2798	0.2346
Observations	470,880	470,880	470,880	470,880
Cochran-Orcutt test (*H_0: zero autocorrelation in errors*)				
	-0.004	0.041	0.048	-0.022
(p-value)	(0.933)	(0.131)	(0.038)	(0.240)

Notes: All regressions include education, sector, and year dummies. **Bold** (*italics*) indicates significance at the 1-percent (5-percent) level. Clustered standard errors are reported in parentheses.

Notes: Evolution of real labor income implied by specification (4) in Table 5 for a university graduate (edu=17) starting his career at age 30.

Figure 2: Illustration of real labor income growth (relative to start of career).

Notes: Evolution of real net income implied by Table 7 for a university graduate (edu=17) starting his career at age 30. Net income=labor income + capital income - taxes.

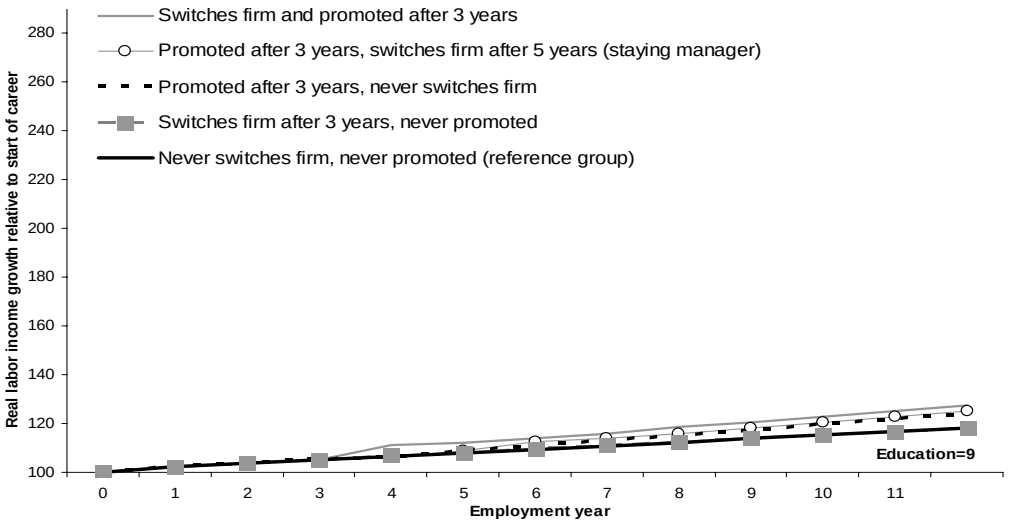
Figure 3: Illustration of real net income growth (relative to start of career).

Table 8: Labor income growth and career mobility (OLS, three lags)

	Full sample	**Edu=9**	**Edu=12**	**Edu=15**	**Edu=17**
Labor income growth (t-1)	**-0.4**	**-0.37**	**-0.376**	**-0.458**	**-0.378**
	(0.028)	(0.084)	(0.036)	(0.050)	(0.090)
Labor income growth (t-2)	**-0.249**	**-0.211**	**-0.201**	**-0.309**	**-0.309**
	(0.029)	(0.057)	(0.032)	(0.054)	(0.101)
Labor income growth (t-3)	**-0.105**	**-0.098**	**-0.078**	**-0.143**	**-0.132**
	(0.014)	(0.023)	(0.018)	(0.031)	(0.038)
Non-manager horizontal move, within-firm (HWF)	–	–	–	–	–
Non-manager horizontal move, cross-firm (HCF)	**0.008**	*0.004*	**0.005**	**0.017**	**0.021**
	(0.001)	(0.002)	(0.001)	(0.003)	(0.003)
Promotion, within-firm (PWF)	**0.017**	-0.004	**0.016**	**0.022**	**0.03**
	(0.002)	(0.006)	(0.003)	(0.004)	(0.009)
Promotion, cross-firm (PCF)	**0.066**	**0.042**	**0.062**	**0.076**	**0.066**
	(0.007)	(0.013)	(0.009)	(0.012)	(0.024)
Manager horizontal move, within-firm (ManHWF)	**0.013**	**0.01**	**0.011**	**0.017**	**0.019**
	(0.001)	(0.003)	(0.002)	(0.003)	(0.004)
Manager horizontal move, cross-firm (ManHCF)	**0.041**	0.024	**0.029**	**0.054**	**0.053**
	(0.003)	(0.014)	(0.005)	(0.006)	(0.009)
Demotion, within-firm (DWF)	0.007	-0.012	0.008	0.008	0.002
	(0.008)	(0.013)	(0.005)	(0.005)	(0.009)
Demotion, cross-firm (DCF)	0.006	-0.014	-0.017	***0.03***	0.02
	(0.008)	(0.021)	(0.011)	(0.012)	(0.031)
Age/10	**-0.065**	***0.033***	**-0.048**	**-0.094**	**-0.189**
	(0.007)	(0.015)	(0.007)	(0.019)	(0.037)
$Age^2/100$	**0.005**	-0.005	**0.003**	**0.006**	**0.015**
	(0.001)	(0.002)	(0.001)	(0.002)	(0.004)
Education=9	–				
Education=12	**0.004**				
	(0.000)				
Education=15	**0.012**				
	(0.001)				
Education=17	**0.021**				
	(0.001)				
constant	**0.224**	-0.033	**0.165**	0.009	**0.599**
	(0.017)	(0.033)	(0.018)	'(0.015)	(0.096)
R^2	0.1441	0.1389	0.1283	0.1866	0.1389
Observations	470,880	83,704	264,372	89,218	33,586
Unique individuals[a]	58,860	10,615	33,291	11,399	4,249
Cochran-Orcutt test (*H_0: zero autocorrelation in errors*)					
	-0.004	-0.313	-0.067	-0.013	-0.004
(p-value)	(0.933)	(0.000)	(0.126)	(0.759)	(0.933)

Dependent variable: Change in real log labor income $ln(LI_t) - ln(LI_{t-1})$.

Notes: All regressions include sector and year dummies. **Bold** (*italics*) indicates significance at the 1-percent (5-percent) level. Clustered standard errors are reported in parentheses. [a] Sum of individuals in subsamples exceeds 58,860 because some persons increase education and appear in different regressions for the relevant subperiod of their career.



Notes: Evolution of real labor income implied by Table 8 for a person with less than high school (edu=9) starting his career at age 30.

Figure 4: Illustration of real labor income growth (relative to start of career, edu=9).

Notes: Evolution of real labor income implied by Table 8 for a high school graduate (edu=12) starting his career at age 30.

Figure 5: Illustration of real labor income growth (relative to start of career, edu=12).

Notes: Evolution of real labor income implied by Table 8 for a person with college or post-secondary professional training (edu=15) starting his career at age 30.

Figure 6: Illustration of real labor income growth (relative to start of career, edu=15).

Notes: Evolution of real labor income implied by Table 8 for a university graduate (edu=17) starting his career at age 30.

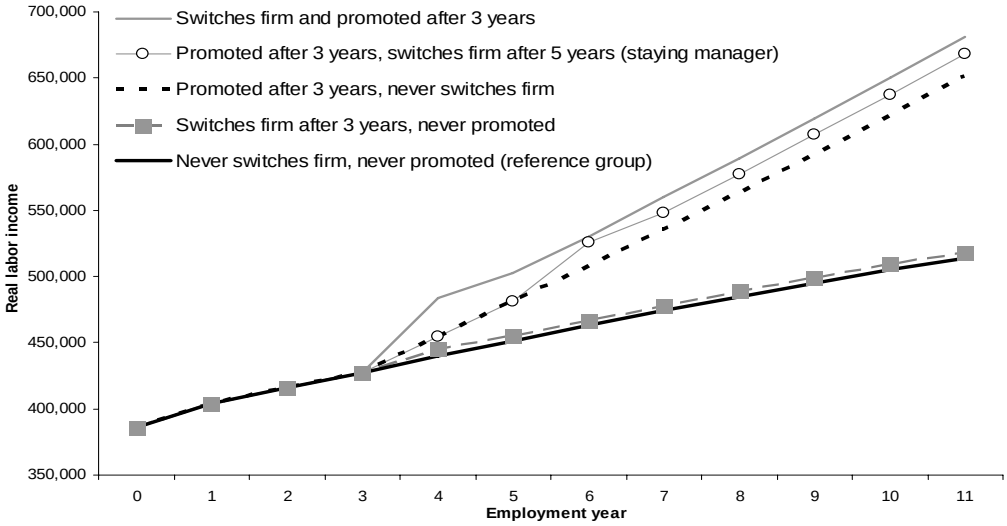
Figure 7: Illustration of real labor income growth (relative to start of career, edu=17).

Table 9: Labor income growth and career mobility (GMM)

	OLS	**GMM**
Labor income growth (t-1)	**-0.400**	**-0.301**
	(0.028)	(0.017)
Labor income growth (t-2)	**-0.249**	**-0.097**
	(0.029)	(0.008)
Labor income growth (t-3)	**-0.105**	
	(0.014)	
Non-manager horizontal move, within-firm (HWF)	–	–
Non-manager horizontal move, cross-firm (HCF)	**0.008**	**0.012**
	(0.001)	(0.001)
Promotion, within-firm (PWF)	**0.017**	**0.034**
	(0.002)	(0.004)
Promotion, cross-firm (PCF)	**0.066**	**0.096**
	(0.007)	(0.008)
Manager horizontal move, within-firm (ManHWF)	**0.013**	**0.040**
	(0.001)	(0.004)
Manager horizontal move, cross-firm (ManHCF)	**0.041**	**0.076**
	(0.003)	(0.006)
Demotion, within-firm (DWF)	0.007	**0.009**
	(0.008)	(0.003)
Demotion, cross-firm (DCF)	0.006	**0.032**
	(0.008)	(0.009)
Age/10	**-0.065**	
	(0.007)	
$\text{Age}^2/100$	**0.005**	**-0.003**
	(0.001)	(0.000)
constant	**0.224**	**0.068**
	(0.017)	(0.017)
Observations	470,880	529,740
Number of instruments		372
Arellano-Bond test (H_0: *zero autocorrelation in first-differenced errors*)		
m_1 (p-value)		-6.864 (0.000)
m_2 (p-value)		-0.605 (0.545)

Dependent variable: Change in real log labor income $ln(LI_t) - ln(LI_{t-1})$.

Notes: OLS regression includes education, sector, and year dummies. **Bold** indicates significance at the 1-percent level. Clustered standard errors are reported in parentheses.



Notes: Evolution of real labor income implied by the GMM estimates in Table 9 for a university graduate (edu=17) starting his career at age 30.

Figure 8: Illustration of real labor income growth (GMM estimates).

Table 10: Descriptive statistics for female sample (at start of panel in 1994)

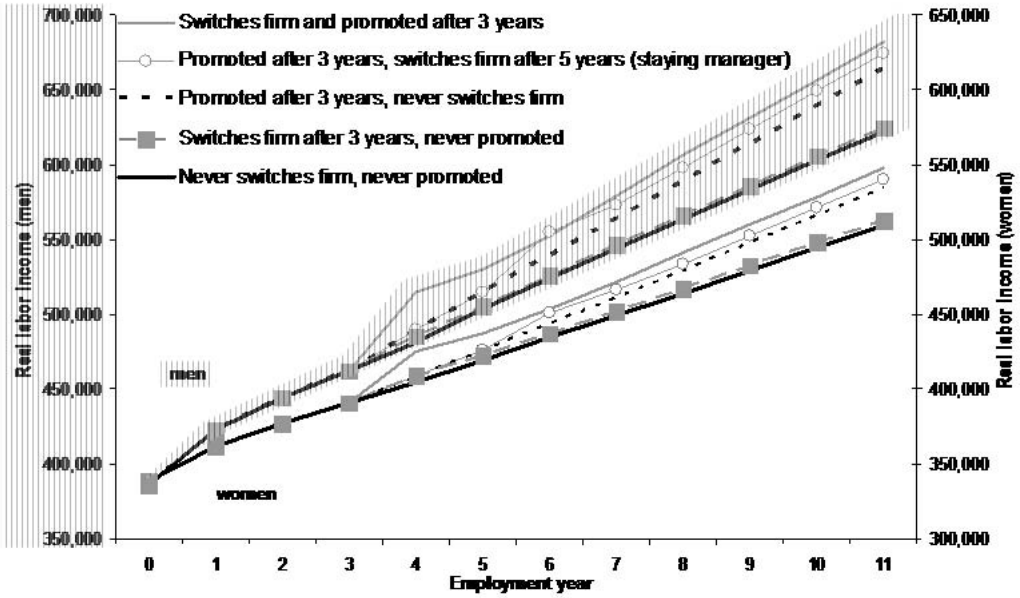
Age[a]	38.04
	(4.48)
9 years (less than high school)	22.42%
12 years (high school)	60.44%
15 years (college or post-secondary professional training)	13.44%
17 years (university degree)	3.70%
Real labor income[a,b]	262,310
	(81,082)
Firm size[a] (number of employees, employee weighted average)	3,473
	(4,541)
Average proportion of employees working as managers	1.99%
Unique individuals	26,506
Person-year observations (1994 - 2005)	7318,072

Notes: Panel of women aged 30 to 45 in 1994, continuously employed between 1994 and 2005 in private firms with at least 25 employees. [a] Mean (standard deviation).
[b] Year-2000 Danish Kroner (DKK). DKK 100 = 12 U.S. dollars (in year 2000).

Table 11: Mobility patterns for female sample

	percent	**percent of group** (annual transition probability)
All transitions	**100**	
Within-firm moves		89.87
Cross-firm moves		10.13
Non-management	**97.68**	**100**
$\boldsymbol{Non\text{-}management_{t-1} \rightarrow Non\text{-}management_t}$		
horizontal move, within-firm (HWF)	87.37	89.44
horizontal move, cross-firm (HCF)	9.82	10.05
$\boldsymbol{Non\text{-}management_{t-1} \rightarrow Management_t}$		
$\boldsymbol{Non\text{-}management_{t-1} \rightarrow Management_t}$		
promotion, within-firm (PWF)	0.41	0.42
promotion, cross-firm (PCF)	0.08	0.08
Management	**2.32**	**100**
$\boldsymbol{Management_{t-1} \rightarrow Management_t}$		
horizontal move, within-firm (ManHWF)	1.77	76.27
horizontal move, cross-firm (ManHCF)	0.16	6.91
$\boldsymbol{Management_{t-1} \rightarrow Non\text{-}management_t}$		
demotion, within-firm (DWF)	0.32	13.78
demotion, cross-firm (DCF)	0.07	3.03

Notes: 291,566 person-year observations 1995-2005 (26,506 unique individuals).



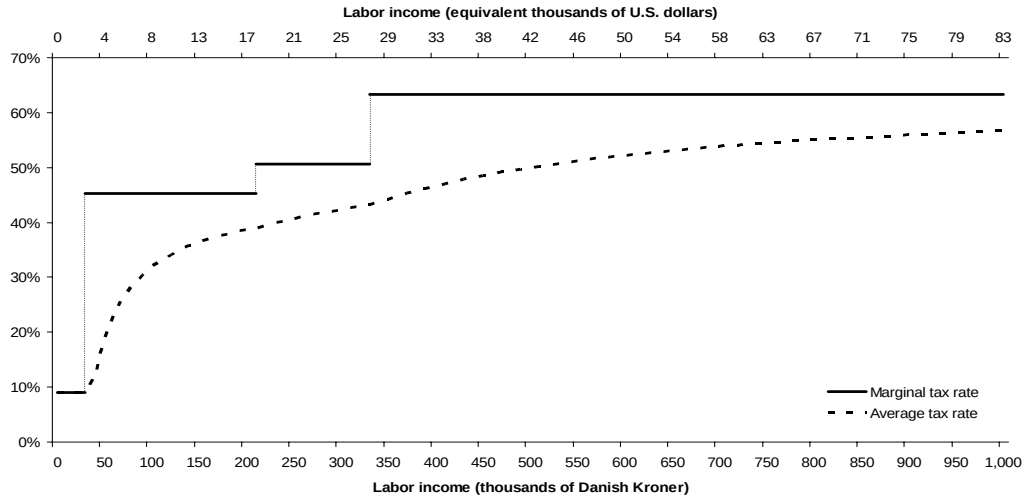
Notes: Evolution of real labor income implied by estimates in Table 5 (Men) and Table 12 (Women) for a university graduate (edu=17) starting his or her career at age 30.

Figure 9: Illustration of real labor income growth (Men versus women).

Table 12: Income growth for female sample (OLS, three lags)

	Labor income	**Personal income**	**Taxable income**	**Net income**
Labor income growth (t-1)	**-0.340**	**-0.611**	**-0.549**	**-0.472**
	(0.057)	(0.023)	(0.021)	(0.031)
Labor income growth (t-2)	**-0.226**	**-0.349**	**-0.295**	**-0.291**
	(0.064)	(0.022)	(0.019)	(0.024)
Labor income growth (t-3)	**-0.104**	**-0.153**	**-0.139**	**-0.150**
	(0.029)	(0.014)	(0.012)	(0.014)
Non-manager horizontal move, within-firm (HWF)	–	–	–	–
Non-manager horizontal move, cross-firm (HCF)	**0.011**	**0.014**	**0.014**	*-0.008*
	(0.001)	(0.003)	(0.003)	(0.003)
Promotion, within-firm (PWF)	*0.011*	**0.031**	0.032	-0.005
	(0.005)	(0.022)	(0.022)	(0.018)
Promotion, cross-firm (PCF)	**0.050**	**0.066**	*0.095*	0.060
	(0.012)	(0.013)	(0.039)	(0.036)
Manager horizontal move, within-firm (ManHWF)	**0.009**	**0.018**	**0.021**	0.008
	(0.002)	(0.007)	(0.007)	(0.006)
Manager horizontal move, cross-firm (ManHCF)	**0.026**	**0.068**	**0.073**	-0.035
	(0.007)	(0.014)	(0.013)	(0.044)
Demotion, within-firm (DWF)	-0.008	0.008	0.015	0.022
	(0.006)	(0.014)	(0.017)	(0.034)
Demotion, cross-firm (DCF)	-0.034	0.037	0.033	-0.098
	(0.021)	(0.040)	(0.047)	(0.084)
Age/10	-0.017	**0.097**	**0.144**	*-0.048*
	(0.009)	(0.029)	(0.033)	(0.024)
$Age^2/100$	0.000	**-0.013**	**-0.018**	0.004
	(0.001)	(0.003)	(0.004)	(0.003)
constant	**0.099**	**-0.189**	**-0.272**	**0.199**
	(0.022)	(0.070)	(0.079)	(0.054)
R^2	0.0999	0.3093	0.2701	0.1502
Observations	212,048	212,048	212,048	212,048
Cochran-Orcutt test (*H_0: zero autocorrelation in errors*)				
	-0.010	0.052	0.046	-0.021
(p-value)	(0.902)	(0.137)	(0.116)	(0.588)

Notes: All regressions include education, sector, and year dummies. **Bold** (*italics*) indicates significance at the 1-percent (5-percent) level. Clustered standard errors are reported in parentheses.



Notes: Assumes that the person lives in a municipality with "average" tax rates, and that he does not have any positive or negative capital income or other income, and no deductions.

Figure 10: Income tax schedule for 2000.