The Dynamics of Self–employment and Household Wealth: New Evidence from Panel Data

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Abstract

The two questions whether self–employment determines wealth accumulation and thus contributes to explaining the shape of the cross–sectional wealth distribution, or whether wealth accumulation determines selection into self–employment, for instance because of binding liquidity constraints, have received much attention in the literature, but heretofore have been treated separately. We improve on this literature by modeling occupational choice and wealth accumulation as a joint decision process. We use household panel data that allow both modeling simple employment and wealth dynamics and distinguishing between (correlated) unobserved heterogeneity (such as tastes and abilities) and (own and cross) state dependence.

Apart from the expected, strong positive state dependence, we do find a strong positive effect of self–employment on wealth accumulation, but no effect of wealth holding on selection into self–employment. Correlations between unobservables are documented to be an important ingredient of the model, and their omission has repercussions for the estimates of the dynamic processes.

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1 Introduction

In recent years, self–employment has received considerable policy attention in various countries around the globe. The transition into self–employment explains much of the creation of new enterprises, as in almost any country the size distribution of businesses is very strongly skewed to the right. These many small firms, however, are believed to be important for a country's development and growth since they act as an engine of employment growth and are also important in the technological invention and innovation processes.

The particular country under study in the present paper is the Netherlands. Here, the percentage of self–employed is relatively low by international standards, and also rates of entry and of fast growing businesses are comparatively low. At the same time, the administrative burden placed on start ups is considerable (figures circulating put it at the equivalent of about a fifth of per capita GDP), entry regulations and establishment stipulations are tight, and financial constraints are considered to be important impediments to nascent and newly developing businesses. Policy makers became aware of the low numbers of self–employed and during the second half of the 1990's and early 2000's, authorities have started a range of initiatives to foster business start–up and to reduce risk during the first years of a newly born enterprise, among which financial support, credit guarantees, and special tax provisions.

However, whether or not administrative and other start–up costs, financial market imperfections such as liquidity constraints keep the self–employment (growth) rates low, or whether the Dutch have a taste for working as employees, is far from clear. Given current auditing and publication requirements for unincorporated businesses, micro data on small firms' finances are hard to come by, and direct evidence on the existence and importance of financing constraints for starting entrepreneurs is sparse.

We propose a different angle, following a recent literature on self–employment choices and *household* wealth holding. For one, the availability of data sources covering household financial positions is somewhat better. Here, representative data are available that allow detailed analysis of consumer finances. Since the overwhelming number of new businesses is very small and managed by the owner, entrepreneurship or business ownership and self–employment will be very closely related.[1] At the same time, the vast majority of these new little firms are unincorporated businesses, whose access to outside capital may be distinctly more difficult. Irrespective of whether

[1]In line with the rest of the literature, we make in fact no distinction between the self–employed, business owners, and entrepreneurs, and no distinction between entrepreneurial ability and business skills.

banks (and other lenders) explicitly ask owners to pledge personal assets as collateral for loans, or whether liability laws implicitly grant lenders access in case of loan default, one may expect personal wealth to matter for the availability of external finance. Besides, owner's assets will often also be the primary source for internal finance of starting businesses, such that a positive correlation between household wealth and the transition into and survival in self–employment is frequently observed.

On the other hand, a positive correlation between household resources and the self–employment decision is not evidence of the first causing the second. We know from the empirical literature that entrepreneurs differ in many important aspects from otherwise observationally equivalent people in the population. In particular, risk attitudes, tastes for wealth accumulation, and dynastic preferences, may arguably be correlated with business skills and entrepreneurial success. Hence, people that are good in pursuing business ideas may also be good at accumulating wealth, reversing the direction of causality to explain the aforementioned empirical regularity. The skewness of the cross–sectional wealth distribution as documented in many countries, and in particular the wealth holding patterns of the very rich may arguably be an outcome of such a process.

While self–employment and wealth holding may interact directly, it should also be noted that past self–employment is a good predictor of current self–employment, as much as past wealth is a good predictor of current wealth. Of course, the observation may be due to true state dependence (exposure to an event in the past increases the likelihood of experiencing it again) or to spurious state dependence (past experience is a proxy for tastes and other unobservables that determine selection into the process). In order to avoid picking up the latter, an empirical model should therefore model the unobserved heterogeneity.

Hence, our modeling strategy is to extend existing dynamic random effects models to the case of a hybrid model with a binary choice equation for self–employment and a linear equation for wealth, accounting for interactions between the equations in the following way: the bivariate model allows explaining the correlation between self–employment and lagged wealth holding (or reverse) from correlations between the unobserved heterogeneity terms (correlated random effects) as well as from state dependence across equations (we include lagged endogenous variables of *each* type in *both* equations). We further suggest assessing the assumptions of uncorrelatedness of regressors and individual effects indirectly using a linear model that lends itself to testing overidentifying restrictions.

The empirical analysis is based on an unbalanced sample from the 1993–1998 waves of the CentER Savings Survey. The distinguishing feature of this survey (in comparison to others that have been used in the empirical self–employment literature) is the detail of information on the portfolio structure of household wealth which is available for a number of consecutive years for the same households. The data consists of a sub–sample designed to be representative for the Dutch population, and of a (smaller) sub–sample from the highest income decile. Since self–employment and wealth holding are positively correlated, this makes the data particularly useful for our purposes. Due to the shortness of our panel, we will restrict the analysis to simple AR(1) processes.

The main purpose of this paper, and its addition to the literature, is to increase understanding through which channels the self–employment choice and the wealth accumulation process interact. For instance, it will be interesting to know if, controlling for wealth and risk attitude, individual effects like entrepreneurial ability or tastes are important in the self–employment choice, and if these tastes are correlated with preferences to accumulate wealth. This may be relevant, for instance, in cases where hard–wired dynastic preferences are determining behavior.

According to our preliminary results both (positive) own state dependence and unobserved heterogeneity are important features of the data. In addition we find that while the self–employed accumulate more wealth, a higher level of assets does not increase the selection into or the survival in self–employment. Also, the correlation of the unobserved heterogeneity terms is an important ingredient to the empirical model, as results from univariate models suggest, where this correlation is zero.

The remainder of this paper is organized as follows. In the next section, we delineate both the policy issues relevant for the institutional setting in the Netherlands and theoretical and empirical issues as they have been discussed in the recent literature on self–employment and wealth holding. The micro data we use are described in Section 3. Descriptive evidence on raw correlations and transitions is presented in Section 4. Section 5 spells out the econometric methods that we employ for the empirical analyses, whose results are presented in Section 6. Section 7 concludes.

2 Issues

2.1 Institutions and Policy Issues in the Netherlands

The Netherlands at the end of the 1990's had about half a million small and medium sized enterprises (SMEs; the typical threshold value is 100 employees, thus far smaller than the conventional US definition of up to 500 employees for small and medium sized enterprises). These accounted for about 98.8% of all private sector enterprises, and contributed 31.6% to GDP and about 45% of private sector GDP. They employed roughly 55% of all private sector workers.

Van Gelderen *et al.* (2001) estimate that about 200,000 people (or 3.8% of the total labor force) were about to set up a business in 1998, of whom less than half (47%) actually got started within two years, a quarter (27%) were still in the process and the rest (26%) had given up. Reasons behind the low success rate may have to do with substantial difficulties of starting entrepreneurs in terms of both administrative red tape (increasing the opportunity costs of starting a business) and access to external finance.

Policy makers are aware of both the importance of the small business sector and existing hurdles. At least, the number of policy measures taken towards the second half of the 1990's points at increased government efforts to promote and facilitate entrepreneurship. The explicitly stated goal of government policy was an increase in business start ups by 25% by 2001, from 40,000 to 50,000 new businesses.

Lundström and Stevenson (2002) give a concise overview of recent developments and policy measures taken. They range from a major reform of bankruptcy regulations, a new Competition Act, revisions in the Establishment Act and other changes to the regulatory framework, over various changes in tax laws, special subsidized credit schemes and credit guarantees for entrants from the non–active population (such as previously unemployed or disabled), to awareness campaigns for existing support schemes, simplification of administrative procedures, and efforts to increase entrepreneurial aspects in the education system at all levels. Particular attention is paid to ethnic entrepreneurs and women, but also to high growth businesses and starting high tech firms. Policy measures are not only meant to provide help in getting started as an entrepreneur, but there are also special provisions to help existing entrepreneurs bridging temporary periods of financial distress, or to help older owners of dying businesses transit into retirement. These measures are typically means–tested, however, in the sense that market solutions must appear infeasible (e.g. no access to bank finance).

2.2 Theoretical and Empirical Issues on Self–Employment and Wealth Holding

A growing body of literature studies the decision to become self–employed, or the transitions out of self–employment into retirement or other labor market states. There is also a growing number of papers studying the determinants of entrepreneurial success and growth.

The occupational choice literature is too large to review here (see for instance, Le (1999) for a survey), but some of the important factors deserve mentioning. First, self–employment responds to changes in labor market conditions and personal employment history. During periods of high unemployment, the outside option of becoming self–employed may increase in value and induce the unemployed to seek their luck in setting up their own business ('push' effect), while previous unemployment spells may deteriorate one's own success in setting up a business, and previous self–employment spells may act as catalyst to future ones (Evans and Leighton (1989), Carrasco (1999), Martinez-Granado (2002), Taylor (1999)).

Second, selection into entrepreneurship may have to do with education and experience (i.e. human capital factors), or related and typically unobservable factors such as entrepreneurial talents, ability, or business skills. However, empirical findings relating to education and experience vary by a large degree, and may be influenced by whether or not occupational status is controlled for (Le (1999)). These variables seem to play a more decisive role in determining self–employment *survival*. Cressy (1996), using firm–level data from a British bank, documents human capital to matter more than financial capital, challenging the findings of Holtz–Eakin *et al.* (1994b). Experience on the job can also be assessed using duration models. Carrasco (1999) and Martinez-Granado (2002) find positive duration dependence.

Third, and most important for the current paper, one typically observes a positive correlation between household wealth and self–employment. An entrepreneur who is not able to provide the desired capital out of his own funds would apply for external finance. Due to capital market imperfections rooted in, for example, asymmetric information, it may however not be in the interest of the lender to extend any credit beyond the collateral that the entrepreneur can pledge (Stiglitz and Weiss (1981)). The requirement to provide matching funds imposes a hard borrowing constraint (or, "no–borrowing" constraint) for the entrepreneur. If the required capital to start a business is exogenously given, we should therefore expect a positive association between wealth held by a household and the probability of transiting into self–employment. In a dynamic model, some prospective entrepreneurs will also be saving for a downpayment.

This hypothesis has been investigated by a number of authors, among which, Evans and Jovanovich (1989), Evans and Leighton (1989), Holtz–Eakin *et al.* (1994a,b), Lindh and Ohlsson (1996), Dunn and Holtz-Eakin (2000), and Taylor (2001). All these authors find evidence for such a positive relationship. Since in most cases wealth is not strictly exogenous, the need to find suitable instruments arises. Blanchflower and Oswald (1998) and

Holtz–Eakin *et al.* (1994a,b) use inheritances received, Lindh and Ohlsson (1996) and Taylor (2001) use (mainly) lottery winnings as windfall gains to instrument for wealth.

However, since most start–up businesses will be rather small with an owner–manager and at most a handful of employees, projects tend to be small, requiring modest amounts of starting capital. This is argued by Hurst and Lusardi (2002), who find a positive relationship between wealth and self-employment only at the upper decile of the net worth distribution—a fact that can hardly be ascribed to liquidity constraints. They use the PSID and instrument wealth with average regional house price changes.

Dunn and Holtz-Eakin (2000) also stress the importance of intergenerational links such as parental experiences and correlated intergenerational preferences. They find that especially parental self–employment experience exerts a larger positive impact on children's self–employment transition than parental wealth, which in itself is found important. Other papers that address the importance of parental occupation in the self–employment decision are Blumberg and Pfann (2001), Henley (2000), and Taylor (1999).

Finally, there are other (often unobservable) preference parameters that may be important, like risk aversion or economic independence. Moskowitz and Vissing-Jørgensen (2002) analyze the risk and return structure of non–publicly traded, private equity. They estimate that private equity has a similar return as public equity but worse risk characteristics. Given the exposure of self–employed to private equity, the fact that their portfolios are not better diversified, represents a puzzle. Higher risk tolerance is one of the possible explanations, another one is a preference to "be one's own boss". This latter possibility is also considered by Hamilton (2000) who documents that the median returns to self–employment are actually lower than for paid employment. This makes non–pecuniary (and unmeasured) returns a likely candidate for explaining self–employment choice.[2]

Wealth accumulation may, on the other hand, itself be driven by successful business owners and their higher saving rates. Hence, entrepreneurship may explain the high concentration of cross–sectional wealth in the hands of a few. The latter is documented by Quadrini (1999), Gentry and Hubbard (2000), and Cagetti and DeNardi (2001). Having analyzed the impact of

[2] Blanchflower (2000) documents higher subjectively felt job satisfaction of self–employed compared to employees in a number of OECD countries. Also intriguing is the finding by Blanchflower *et al.* (2001) that, when asked if they preferred to be employed or self–employed, a huge number of people (relative to the actual self–employed) expressed their desire to be self–employed. Striking are the differences across the 23 listed (mostly OECD) countries. The Netherlands rank 20, suggesting that the Dutch do not want to become self–employed as much as other nations, save for Scandinavian countries.

wealth on the transition to self–employment, the saving–for–downpayment hypothesis, and the use of inheritance as an instrument, Hurst and Lusardi (2002) come to the conclusion that it is likely that families with preferences for inheritances may also be the ones that have a preference for entrepreneurship, yielding inheritances invalid as instrument for wealth in a self–employment equation.

The literature summarized so far defines the point of departure for the present paper. An empirical model for self–employment dynamics (entry, survival and exit) will be presented that allows for true state dependence and unobserved heterogeneity. At the same time, we allow wealth to impact self–employment with its lagged value. Wealth in itself, however, is allowed to depend on previously accumulated wealth, lagged employment choices, and on unobserved individual effects. Since the unobservables in both equations will pick up preferences, we allow both the unobserved heterogeneity terms and the idiosyncratic errors to be correlated across equations. The choice of a random effects structure allows to make this correlation structure explicit.

Note that this approach is an addition to the existing literature on self–employment and its relation to wealth, because the above mentioned studies do not trace out the development of self–employment over time but study two–wave transitions instead. This is in part due to the fact that panels are either extremely short (SCF), panel components of existing data set are small (SCF), or wealth observations are sparsely timed (PSID). Henley (2000) is a notable exception, using eight waves of data from the British BHPS. However, he estimates a univariate dynamic model of self–employment, but without instrumenting wealth and without considering possible feedback effects from self–employment on wealth. Also, his wealth measure is confined to real home values.

3 Data

We use the first six waves of the CentER Savings Survey (CSS), detailed descriptions of which are available in Alessie *et al.* (2002) and Nyhus (1996).[3] For most of the observation period, the panel consists of two samples. The first is designed to be representative of the Dutch population (REP), but suffers from survey non-response. It contains approximately 2000 households in each wave, including refreshment samples compensating for panel attrition. The second sample represents the upper decile of the income distribution (HIP). Initially, it consisted of about 900 families, but has no refreshment samples. It is available in each wave except the final one. We combine

[3]The CSS was formerly known as 'VSB panel'.

REP and HIP samples. In the descriptive statistics below in Section 4, we correct for non–randomness in sampling by using sample weights. A closer description of these weights is also available in Alessie *et al.* (2002).

The CSS data were collected via on–line terminal sessions, where each respondent household was provided with a suitable on–line device to the extent that they did not have a PC and modem at home.[4] The survey questions elicit general information on the household and its members, including labor market status, health status, and many types of income. Important for our purposes are the questions on self–employment, and assets and debts.

There are two principal ways to determine if someone is self–employed. One is based on self–declared professional activity or labor market status. Based on the responses in the first few waves of the panel, the data collection agency felt that the electronic questionnaire design may have led to biased responses. In particular, the routing would not clearly state self–employment as an alternative to private sector or government employment in the lead–in question, and further it was not possible to clearly distinguish between self–employed entrepreneurs and free–lance workers, and other activities without employment contract. The subsequent revision of the questionnaire from wave 1997 on thus leads to a structural break in the series that is hard to accommodate in our empirical model where employment transitions are important. The other possibility to determine self–employment is to exploit information in the wealth questionnaire. Here, respondents were asked if they were either "the director or a (main) shareholder of a private limited company", "participated in a partnership or firm", or simply "were self–employed".

We settle on this second definition, even though there is a third possibility that would determine entrepreneurship from the ownership or balance of business equity held. Such a definition would be broadly consistent with that of Gentry and Hubbard (2000) who apply an additional threshold of at least 5,000$ business asset holding. We abstain from adopting this purely asset–based definition because the questionnaire will not allow us to determine the control rights within the firm that business equity holders have. Also, as documented by, for instance Hurst and Lusardi (2002), a large number of new entrepreneurs have starting capital of below 5,000$ (and possibly zero or negative equity). Excluding them from the analysis may lead to biased estimates.

In terms of other observables, we typically use the characteristics of the

[4]The interviewing mode has changed from 2000 onwards. The data are now mainly collected via internet. Differences in interviewing method, revisions in the questionnaires, and unavailability of sampling weights for panel waves beyond 1998, let us abstain from using the last two available waves 1999 and 2000 at the moment.

head of household. Exceptions are the marginal tax rate, income and wealth that relate to the entire household. Especially for the latter two it is not necessarily clear where to draw the line between household members in terms of control over resources. Income is measured as non–capital income, and is the sum of a number of possible income sources, especially wage income, or social security benefits, but excluding business income. For observations with missing income, we predict income from background variables such as family size and education level and age of the head of the household.

In terms of wealth, the questionnaire distinguishes about forty different asset and debt categories. Typically, respondents first indicate whether they own the type. If they do, they are asked a series of questions on amounts and the precise nature of each asset in that category. Non–response in the ownership questions is negligible, but item non–response in various questions on the amounts is substantial. See again Alessie *et al.* (2002) for a more detailed description on particular portfolio positions. We also follow their approach to impute missing values because item–nonresponse poses a serious threat to the usefulness of overall wealth concepts (i.e. the sum of individual asset and debt positions; missing values in any of them will result in missing values for the sum). The imputed values are based upon amounts held in adjacent years, and on the use of regression models relating the observed amounts to household characteristics. We add prediction errors drawn from the estimated error term distribution in the regression models, taking full account of the covariance structure of these error terms over time.

The descriptives presented below in Section 4 display a range of portfolio components that are defined as follows:

`STCKS1` Stocks and shares, including shares of substantial holding: the latter are shares in a company's equity of 5% or more; they are probed separately in the questionnaire since they are subject to different tax rules (corporate tax rather than income tax).

`STCKS2` Stocks and shares, excluding shares of substantial holding: this more narrow concept is used since it appears that stocks of substantial holding are particularly favored by the self–employed.

`FINASS` Financial assets: this includes assets like saving accounts and deposits, checking account balances, shares and stocks of any kind, bonds, and mutual funds. Financial assets can most easily be transferred into other forms of wealth, which may be an important consideration when acquiring business equipment.

`FINDBT` Financial liabilities: these include consumer credit (such as installment and mail order debt), personal loans, checking account overdrafts, credit card balances and other revolving loans, student loans, etc., but not mortgages of any kind.[5] To the extent that there is widespread information sharing among lenders, the amount of financial liabilities may signal creditworthiness or credit risk.

`TPNETW` Total personal net worth: the sum of financial assets and non–financial assets minus the sum of financial liabilities and mortgages. Non–financial assets include in particular residential and non–residential real estate, and vehicles of various types (cars, caravans, motorcycles, boats). This is the most comprehensive wealth concept and may signal total borrowing capacity of the household. Note that it does not include business equity.

`BUSEQU` Business equity: Unfortunately the data are silent about any other feature of this wealth position, and do not list business assets and business liabilities separately.

`HOUSEQ` Housing equity: owner occupied housing represents the largest asset in household portfolios on average; this is in particular true of those about 50% of all families that own their homes. Homes typically also represent a substantial fraction of the borrowing capacity, even though mortgages are frequent. Since it is not uncommon, though, to obtain mortgages that exceed the value of the home, even highly leveraged households may find additional scope for long–term borrowing.

The estimation results will distinguish between financial assets and total personal net worth, however excluding 'shares of substantial holding'. Since the skewness of the distributions will impact on the performance of our maximum likelihood estimator, we subject these wealth measures to some non–linear transformation.[6]

Finally, the subsequent analysis only focuses on heads of households in the age bracket 18–64. Self–employed may have different incentives to retire than other employees or the unemployed. They may have less coverage in pension funds, or be a self–selected pool of people with a taste for working. In order to avoid mixing of such effects with the self–employment transition in retirement age, we focus on the under–65 year olds. For similar reasons we exclude

[5] Note that credit card balances were not widespread in the Netherlands until the mid of the 1990's, because most cards would automatically draw on a checking account after a period of 30 days, thus giving no discretion to accumulate credit card debt.

[6] The transformation used in the analysis is basically logarithmic, accounting for non–positive values, i.e. $\ln(x+1)$ for $x > 0$ and $-\ln(-x+1)$ for $x \leq 0$. The transformation is similar to the hyperbolic sine transformation and both are frequently used when skewed distributions such as wealth or income are encountered.

those that are 'not at risk', to wit the disabled and the (early) retired.[7] Sample restrictions based on industry (especially deselecting agriculture) are not possible.[8]

4 Descriptives

Table 1 depicts the evolution of self–employment rates during the observation period (weighted statistics). There does not seem to be a clearly discernible trend since the self–employment rate hovers around 5.5–8.5%. In the early part of the observation period (1993–1996), the numbers increase, thereafter they fall again. 1998 may not be a very representative year, since by then the high–income sample has essentially been eroded due to attrition. Sampling weights (that are based on home–ownership and income) may not adequately capture this.

[Table 1 about here]

These self–employment rates appear to be relatively low, certainly in international comparison,[9] but also compared to other figures that are sometimes quoted for the Netherlands. Martinez-Granado (2002) quotes a self–employment rate of 11.3% based on OECD Labor Force Statistics for 1995. This number is relative to total employment, thus excluding the nonactive part of the labor force. Some of the discrepancy with our numbers may have to do with them being relative to the total potential labor force (including unemployed and non–workers), but it also might be due to our truncating the sample at age 64 irrespective of labor market status, thus potentially deleting a number of self–employed that work beyond standard retirement age. Also note that we consider household heads as the unit of analysis instead of labor market participants in general, which may fail to 'double–count' spouses that in other data might be separately listed as being self–employed when working in the spouses' business or being self–employed on their own. In general, our figures are comparable with those one obtains from other micro data like the Dutch Socio–Economic Panel, SEP. Most likely, therefore, definitional

[7] Note that due to recent policy changes even the disabled may be 'at risk' of becoming self–employed. These policy changes were however effected only after our observation period ('wet (re–)ïntegratie arbeidsgehandicapten' (Wet REA) of July 1998).

[8] See Blanchflower (2000) for a discussion of selection strategies.

[9] Estimates based on micro data range from 8.7% (1989) in the US (Gentry and Hubbard (2000)), over 11–13% in the UK (Henley, 2000), to 18.5% (1990) in Spain (Carrasco, 1999).

discrepancies between data sources will account for the different levels.[10]

[Table 2 about here]

Table 2 shows transition rates into and out of self–employment. Note that these numbers are not weighted. We find the highest entry rate (number of people that become self–employed conditional on not having been self–employed in the previous year) for the first waves with 4.5%, and strongly declining thereafter. Since the self–employed are arguably a very heterogeneous group, one might have expected to see an increase in starters during the 'New Economy' boom of the late 1990's. It is likely, however, that such a surge just falls out of the observation window as flow data (such as employment) refer to the year preceding the sampling year (i.e. to 1997 for the 1998 wave, etc.). Exit rates (similarly defined) exhibit an increasing pattern over time. On average, about 15% of self–employed cease being in that state in the following year. The entry and exit rates are consistent with the 'push' effect abating during periods of general employment growth.

Self–employment as occupational choice is a persistent state. From the small sample of people that participated in the panel for a five–year period, about 5.7% in the group of non–self–employed in 1993 were self–employed in 1997, which is a much larger number than the other year–on–year transitions reported in the Table. A similar remark applies to the exit rate of 18.2%. Clearly, given the persistence in the employment process, one would expect both rates to increase with the time span of observation. If we look at the balanced sample of households that participated in all six waves (174 households), only three of them have repeated spells of self–employment (i.e. being self–employed in one sample year, not self–employed in another, and again self–employed in some later year).

The numbers in Table 2 compare well with those of, for instance, Henley (2000) who uses the British BHPS. Gentry and Hubbard (2000), using the panel component of the SCF (two surveys spanning the six–year period between the years 1983 and 1989) report an exit rate of 52%, much larger than ours.

[Table 3 about here]

We now turn to a description of household wealth and portfolios, see Table 3. We consider the wealth concepts and portfolio items as described in Section 3: stocks and shares (including stocks from substantial holding) [`STCKS1`], stocks and shares (excluding stocks from substantial holding) [`STCKS2`], financial assets [`FINASS`], financial liabilities [`FINDBT`], total

[10]See also Blanchflower (2000).

personal net worth [TPNETW], business equity [BUSEQU] and housing equity [HOUSEQ].[11] We report means and medians for the entire sample, and for the subsamples of self–employed and non–self–employed.

The following general picture emerges: all distributions are right–skewed, including those for debt components. For all households, housing equity is the largest component of total personal net worth (increasing from 53% to 60%), despite a homeownership of about a half (48% to 51% over the observation period) and increases in mortgage debt over time. There is a strong effect due to house price appreciation during much of the sample period (especially towards the end) that is presumably responsible. Financial assets are the second–most important portfolio component for all households. The observation period was marked by a stock market boom. Since stocks are held (either directly or indirectly) by a minority of people,[12] and since house price appreciation even outstripped stock market returns, it is not surprising that the weight of financial assets in household portfolios decreased (from 45% to 37% of total personal net worth).

The other striking feature of the Table is that self–employed hold much more of any of the wealth components. Due to the small number of observations involved, variation in the numbers will reflect sampling error to a large extent, but some general picture emerges: Mean total personal net worth of the self–employed was four times that of the non–self–employed in 1993 and two–and–a–half times in 1998. Median figures fell from four times to three times, suggesting that the skewness of the wealth distribution increased much more strongly among the non–self–employed than among the self–employed. Even though the self–employed have much higher home ownership rates and hold around two–and–a–half times as much housing equity as the non–self–employed, housing equity has a lower portfolio share (increasing from 33% to 53%). It is about as important as business equity, both of which are in most years less important than financial assets. The latter's importance is decreasing, not only as a portfolio share but also in absolute numbers.[13]

The difference in financial asset holding between self–employed and non–self–employed is mainly due to stock holding. While in the beginning of

[11] All amounts are in 1992 Dutch guilders (using the CPI of Statistics Netherlands). Note, from 1998 on, 1 euro ≡ 2.20 guilders.

[12] Alessie and Hochguertel (2002) report that at most one third of households hold stocks or shares directly, or indirectly through mutual funds, or through pension funds

[13] Observe that housing and financial equity do not add up to total personal net worth, cf. Section 3 above. One of the missing categories is the vehicle stock. Again, note that our net worth concept excludes business equity. Despite a high correlation, the danger of double–counting shares from a substantial holding and business equity is presumably low because the questionnaire explicitly asks to disregard any assets/liabilities from own businesses when probing about personal assets or debts.

the 1990's stock ownership was very concentrated, and in particular business owners would hold large amounts of stocks and shares (both in their own firms and in other traded companies), the stockholder base broadened noticeably during the decade (Alessie *et al.* (2002)). We do see a general increase in stockholding wealth, but we see in particular that the self–employed's stocks position is dominated by shares of substantial holding. Over time, the latter has been substituted with 'regular' shares in the entrepreneurial portfolio. Overall, this reduction contributed much to the total reduction in financial wealth holding of the self–employed. The column reporting financial liabilities shows that the self–employed not only hold much more private debt (excluding mortgages) on average, but debt ownership is particularly wide–spread among them, as even the median assumes non–zero values in most of the years. Finally, the self–employed almost exclusively hold the business equity in the data, which, due to the correlation between business ownership and self–employment, is not surprising as such but a useful check on the consistency of the data.

Summarizing, the wealth statistics from our Dutch data are qualitatively in line with what Gentry and Hubbard (2000), Heaton and Lucas (2000), and Moskowitz and Vissing-Jørgensen (2002) find: business equity constitutes a rather large portion of self–employed's portfolios, and the exposure to additional financial risk via holding of (common) stock is very large as well.

[**Table 4 about here**]

Table 4 reports first differences over time in wealth concepts. Note that the average wealth differences do not exactly match the differences in average wealth of Table 3 because we now consider the balanced panel of people that were in the data at both time t and $t-1$. Also note that the mean figures in this Table are quite volatile, much more than medians. Median figures suggest that the average non–self–employed increased their total personal net worth by about 2,500 guilders a year. Self–employed had much higher changes in wealth, in particular in financial assets.

[**Table 5 about here**]

Table 5 focuses on business starters, i.e. people that became self–employed between year t and $t-1$. We list both median wealth levels at wave t and at wave $t-1$, and changes in wealth between t and $t-1$ and between $t-1$ and $t-2$, respectively. The fact that in the last panel of the table we need wealth lagged two periods reduces the sample size substantially, so that we should probably not make too much of these numbers. It is hard to sketch a general picture from these numbers. For instance, we could compare median personal net worth in year t of business starters with that of non–self–employed in Table 3, which shows that median wealth of starters is much higher than that of non–self–employed. However, as the column on business equity shows, at time t starters do actually report substantial median business equity. Comparing therefore wealth at $t-1$ between starters and non–self–employed may be more meaningful. We do see indeed that the ones that start a business in year t held much more median wealth (total personal net worth) at time $t-1$ than those that were non–self–employed at time $t-1$. A similar comparison of changes in wealth across these two groups shows a similar picture. Perhaps, therefore, people that amassed large wealth in the past either become tempted to start their own business, or they are the ones that have the opportunity to do so.

[**Table 6 about here**]

In terms of demographic and other characteristics, Table 6 illustrates remarkable differences between the self–employed and the non–self–employed. Data refer to the cross section of 1993. The self–employed tend to be slightly lower educated, older, and are more likely to be male. They are also more likely to be partnered and less likely to be divorced or widowed. On the question if they expect substantial future inheritances, they are 50% more likely to answer affirmatively than non–self–employed. Also, they report substantially lower non–capital incomes (which exclude fiscal profits or business income). Nevertheless, they do not, on average, have lower marginal tax rates. Marginal tax rates are computed as the maximum within–household marginal tax rate based on reported incomes from all sources with capital income replaced by its cross–sectional average. Also, self–employed are much stronger represented in the high–income panel, whose inclusion criterion is total gross income. Interestingly, risk aversion does not differ strongly between the two groups. Risk aversion is elicited by asking respondents to which extent (on a scale from 1 to 7) they agree with the following statement: *I think it is more important to have safe investments and guaranteed returns than to take a risk to have a chance to get the highest possible returns.* We coded answers "1" or "2" as 'low risk aversion' and "6" and "7" as 'high risk aversion". Note, that this question has only been posed to respondents with household income of 20,000 Dfl. or more (others are coded "not available").

5 Estimation

Heckman (1981a,b) suggested the use of random effects estimators for modeling dynamic probits based on short panels. We extend the univariate binary model by an additional linear equation, thus the model is a bivariate, hybrid version between a dynamic random effects probit model and a dynamic linear model.

There are two equations, one probit equation for the decision to be self–employed in any one period, and one linear equation for wealth holding in any one period. The self–employment equation depends on its own lagged indicator, the lagged wealth measure and a number of control variables. The wealth equation depends on its own lagged value, the lagged self–employment dummy, and again a number of controls. The error consists of a general disturbance term and a random individual effect. Since we assume both self–employment and wealth decisions to be potentially closely interrelated both directly (via their lagged values) and indirectly via tastes and abilities, we also allow the unobserved heterogeneity terms (ie. the random effects) to be correlated across equations. Estimation is by Maximum Likelihood (ML).

We assume joint normality of the disturbances, but model the bivariate distribution of the individual effects as a discrete distribution. As usual in random effects models, we assume that the individual effects are in fact uncorrelated with the regressors. The latter assumption is hard to test or to relax in the present framework. In the sensitivity analysis provided in Subsection 6.2 we also briefly consider estimating (univariate) linear models by the Generalized Method of Moments (GMM). In that framework, the binary choice equation (self–employment) is modeled as a linear probability model. GMM estimation has the advantage of being more flexible with respect to the necessary assumptions concerning the error structure; in particular, we have some flexibility about deciding which variables are allowed to be correlated with the individual effect and which are assumed to be orthogonal. The random effects model on the other hand, has the advantage that the modeled probability of self–employment is bounded between zero and one, and that we can directly gauge the magnitude of the correlation between unobservables.

In the sequel we will briefly sketch the structure of the random effects model and give a short account of the initial conditions problem, deferring technicalities to Appendix A. Further information on how to estimate the linear model can be found in Appendix B.

5.1 Random Effects Model

The variables are indexed by S to denote self–employment and W for wealth. We use the following notation, where the index for the household is suppressed.

y_{jt}: dependent variables; self–employment dummy ($y_{St} = 1$ if the head of household is self–employed in year t, $y_{St} = 0$ otherwise) and household wealth holding (y_{Wt} is continuous); $t = 1, \ldots, T$.

$\boldsymbol{x}_t$: vector of independent variables, assumed to be strictly exogenous. We can, but need not use the same $\boldsymbol{x}_t$ in both equations.

α_j: random individual effects ($j = S, W$); (α_S, α_W) is assumed to follow a bivariate discrete distribution with support points and associated probabilities as parameters. See Appendix A for details.

u_{jt}: error terms ($j = S, W$; $t = 1, \ldots, T$); (u_{St}, u_{Wt}) are assumed to be bivariate normal with covariance ρ and to be independent over time. We shall need to normalize the variance of the S equation error to unity for identification purposes.

We assume that (α_S, α_W), $\{u_{jt}; j = S, W; t = 1, \ldots, T\}$ and $\{\boldsymbol{x}_t; t = 1, \ldots, T\}$ are independent (which implies that $\boldsymbol{x}_t$ is strictly exogenous).

The model consists of the two following equations:

$$y^\star_{St} = \boldsymbol{x}'_t\beta_S + y_{S,t-1}\gamma_{SS} + y_{W,t-1}\gamma_{SW} + \alpha_S + u_{St} \qquad (1)$$

$$y^\star_{Wt} = \boldsymbol{x}'_t\beta_W + y_{S,t-1}\gamma_{WS} + y_{W,t-1}\gamma_{WW} + \alpha_W + u_{Wt} \qquad (2)$$

$$y_{St} = \begin{cases} 1 & \text{if } y^\star_{St} > 0 \\ 0 & \text{else} \end{cases} \qquad (3)$$

$$y_{Wt} = y^\star_{Wt} \qquad t = 1, \ldots, T \qquad (4)$$

Note that for $t = 1$ the model is not well–defined. To take account of these initial conditions we require a slightly adapted specification for the first period, on which more below in Subsection 5.2.

Dynamic random effects models allow the distinction between unobserved heterogeneity and state dependence. Both can explain why self–employment or wealth holding in period $t + 1$ may be positively correlated with their own lagged values (conditional on observed background variables $\boldsymbol{x}_t$ and $\boldsymbol{x}_{t+1}$). In the bivariate extension, an additional aspect can be addressed relating to possible "spill–over effects" from one equation to the other. If self–employment in period $t+1$ is correlated with wealth holding in period t, this can be due to correlated unobserved heterogeneity (i.e., a non–zero covariance between α_S and α_W) or due to state dependence across equations, i.e., a non–zero value of γ_{SW}. This is important for understanding the dynamics of the self–employment and wealth holding decisions. For example, a positive value of γ_{SW} could mean that wealth holding in the past makes it easier for people to become self–employed, for instance because of bank's collateral requirements or "saving for downpayment". On the other hand, a positive correlation between the random effects would simply mean that the same people who find it attractive to become self–employed also have a preference for holding large amounts of wealth.

5.2 Initial Conditions and Estimation

In a short panel, the question arises how to deal with the correlation between the individual effect and the initial observation. Heckman (1981a,b) suggests for the univariate probit to add static ("reduced form") equations for the first time period similar to the dynamic equations, but without the lagged dependent variables. The coefficients are allowed to be different from the coefficients in the dynamic equations, the random effects are linear combinations of the random effects in the dynamic equations, and the error terms are allowed to have a different covariance structure.

We apply this approach to both equations of our model. In principle, the static equations in the probit case can be seen as linearized approximations of the true reduced form (obtained by recursively eliminating y_{t-1} until $t = -\infty$). The continuous equation in our model is linear anyhow, suggesting that the method should work here as well.

Heckman's simulations suggest that the procedure already works well in short panels, i.e. the approximation error does not lead to a large bias on the parameter estimates.[14]

The complete model can then be estimated by Maximum Likelihood (ML), including the "nuisance" parameters of the static equations. Conditional on the random effects, the likelihood contribution of a given household can be written as a product over all time periods of a normal density and a normal (conditional) probability. The density refers to the continuous observations (wealth), and the probability refers to the binary equation, conditional on the continuous information from the W equation.

Since random effects are unobserved, the actual likelihood contribution is the expected value of the conditional likelihood contribution, with the

[14] See also Chay and Hyslop (2000), who compare various ways to deal with the initial conditions problem in logit and probit models. They find that the probit model with the Heckman procedure performs better than other random effects models.

expected value taken over the two individual effects. This would be a two–dimensional integral if we assumed a bivariate continuous distribution for the random effects.[15] However, since we will be assuming the random effects to be generated by a discrete distribution, the likelihood function is a simple weighted sum of likelihood contributions (see Appendix A for details).

Also note that we will be using the entire unbalanced panel, which is more efficient than using the balanced sub–panel only.[16] We assume that attrition and item non–response are random.

6 (Preliminary) Results

This section presents preliminary results. We focus on specifications pertaining to financial assets, and total personal net worth, both concepts excluding shares from a substantial holding. They enter the model in a log–transformation (see fn. 6). The exclusion of shares of substantial holding is motivated by the high correlation between these shares and business equity, which in itself is an extremely strong predictor of self–employment and may lead to identification problems. In the sequel, we will refer to these (transformed) wealth measures as 'financial assets' and 'net worth' for simplicity.[17]

6.1 Random Effects Estimates

Results for the bivariate model for self–employment and financial assets are presented in Table 7.

[Table 7 about here]

Self–employment today is a strong predictor of self–employment tomorrow. Given that unobserved heterogeneity is controlled for, we may interpret

[15]See Alessie *et al.* (2001) for a bivariate probit model; they use Simulated Maximum Likelihood to integrate out the random effects.

[16]There are some observations with "gaps" (observed for $t = 1, 2, 4, 5, 6$ for example). For computational convenience, these will be used only partially (i.e., in the example above, use $t = 4, 5, 6$ only).

[17]The estimated specifications are based on about 100 parameters, a subset of which is displayed in the results tables. We suppress the parameters of the initial conditions equations, since they are not of core interest. Likewise we do not present estimates of time dummies. Also note that the parameters pertaining to the estimated distribution of random effects have been used to calculate the variances and correlations displayed in the tables. Standard errors have been retrieved using the 'Delta' method. All results tables indicate with asterisks the significance level of associated $t-$tests: $* \equiv 10\%$, $** \equiv 5\%$, $*** \equiv 1\%$.

this is a strong effect of true state dependence. Past experience as a self–employed implies an increased probability to be self–employed in the future. This finding is consistent with self–employed learning how to run a business and it may indicate that business survival is to a large extent driven by entrepreneurial experience. Also, as expected, there is a high own–effect of financial assets in the financial assets equation.

In these equations we also include lagged self–employment in the wealth equation and the lagged wealth in the self–employment equation. There is no evidence of lagged wealth affecting the self–employment choice, which is surprising in light of the bulk of the literature. It is consistent with results of Hurst and Lusardi (2002) who find no impact of wealth on the transition into self–employment (for most of their sample). Hence, we do not find (indirect) evidence of binding liquidity constraints.

In line with the qualitative results of Gentry and Hubbard (2000) and others, we do find lagged self–employment to impact on current wealth. The effect thus survives the additional inclusion of wealth dynamics and unobserved heterogeneity.

Going through the list of demographic and other control variables, we observe that there is no effect of education, neither in the wealth equation nor in the self–employment equation. Unlike in the British data used by Cressy (1996) human capital in our data does not determine self–employment, nor is it correlated with financial asset holdings. Age impacts only on wealth, but not on self–employment. In future regressions we may want to allow for more flexibility in the age pattern, since it may enter the wealth equation nonlinearly. However, since we do truncate the sample at age ≤ 64 and condition on not being retired, dissaving in retirement will not be an issue in our sample. Female headed households do not exhibit different wealth accumulation patterns or self–employment behavior than male headed households. Marital status does not impact on the decision to become self–employed, whereas it obviously has a strong impact on household wealth: divorcees or widows hold less financial assets than singles. In preliminary runs we also included more detail on family composition (number of kids at various ages), without finding them important in either equation.

Income (measured in logs, similar to wealth) is a very strong negative predictor of self–employment, since, as explained in Section 4, it only refers to non–capital, non–business income. The effect runs through both current income and through the average value. Apart from being an important control, we do not wish to give a further structural interpretation. Interestingly, income affects financial assets negatively through its average value (at a significance level of 10%). Note, however, that much of any income effect will be captured by the high–income panel dummy, which has a large and (strongly) significant positive effect on both equations. Marginal tax rates feature positively in both equations. The only significant parameter is associated with the average value in the financial assets equation, however. Considering the fact that both self–employed and wealthy households can enjoy certain tax advantages, possibly achieved by portfolio reallocation, a positive impact of taxes on behavior was expected.

The coefficients on risk aversion do not really suggest that the self–employed are perhaps less risk averse than others. We do find that people with intermediate risk aversion are more likely to be self–employed (significant at the 10% level), but those with low risk aversion are not. We do not find any interpretable effect of risk aversion on financial asset holding.

We have also included time effects in the regressions (without displaying them in the Table). These are (with the exception of 1995) increasingly negative in the self–employment equation and increasingly positive (throughout) in the financial assets equation. In the latter one they will capture the effect of substantial capital gains that accrued during the stock market boom of the late 1990's.

Now turning to the unobserved heterogeneity terms, we find a statistically strongly significant variance of the random effect in both equations. Based on findings in the literature and the documented patterns in the data (see Section 4) we should have expected heterogeneity to be a major descriptive feature of both self–employment and wealth holdings. Both processes are presumably strongly influenced by individual attitudes and preferences, effects of which cannot be controlled for directly. Similarly, we find the random effect to be important in the self–employment equation. Given that education does not play a role, unobserved characteristics such as ability or business skills may determine who will become an entrepreneur and who not.

Finally, the correlations between the idiosyncratic errors and the random effects across equations are relatively large and statistically highly significant (at the 1% level). In particular the correlation between random effects is strong evidence of the same unobservables affecting both wealth accumulation and employment decisions in the same direction. While a direct, structural interpretation of this correlation is precluded, the finding is consistent with correlated preferences driving both processes.

Results based on using total personal net worth as the relevant wealth concept can be found in Table 8.

[Table 8 about here]

We shall restrict ourselves to a short description of the main differences between Tables 7 and 8. The estimates pertaining to the self–employment equation are very similar to those of Table 7. Again, we find no evidence that lagged wealth determines current self–employment. This corroboration of absence of any wealth effect is even more surprising since the concept of total personal net worth should be a better indicator of the total borrowing capacity of households since especially housing equity is accounted for.

Differences in the wealth equation are somewhat more prevalent, but qualitatively the conclusions stay the same. One of the differences is that couples hold more net worth than singles, much of it being presumably attributable to differences in housing equity. Also, the impact of the marginal tax rate changes: whereas financial assets are influenced by the average tax rate over all sample years, net worth responds directly and positively to changes in the contemporaneous tax rate.

Note that the state dependence parameter for wealth is smaller in the net worth equation than in the financial assets equation, which point at smaller (relative) changes in net worth over time. On the other hand, the coefficient of lagged self–employment is much larger in the net worth equation, presumably since most of the wealth difference between self–employed and others consists of differences in housing equity.

Finally, the estimated distribution of the random effects looks markedly different. Variances of random effects are much larger in the net worth case, and also the correlation between the unobserved heterogeneity terms is much more pronounced for the net worth regression. Again, this may make sense in the light of preferences for inheritances and keeping in mind that the largest assets that are transferred intergenerationally are houses (and perhaps other durables or illiquid assets).

It is further instructive to investigate if our parameter estimates change a lot if we only consider similar univariate models (which have been considered by, for instance, Henley (2000)). Table 9 presents a comparison for the parameters of the self–employment and wealth dynamics.[18]

[**Table 9 about here**]

We find the following differences compared to the bivariate models: in both specifications, the bivariate models estimate a much higher coefficient of lagged self–employment in the self–employment equation. These differences will also translate into differences in marginal effects (i.e. the change in the probability of being self–employed in year t when self–employment status is changed from zero to one in year $t-1$). Furthermore, we see substantial differences in the impact of lagged self–employment on accumulating net worth when estimates are based on a univariate model. Again, the effect is

[18] Other results available upon request.

much weaker than we find with the bivariate model.

These results suggest that univariate models that do not account for the correlation between unobservables can result in quite different magnitudes of the parameters of the estimated dynamics. Policy conclusions that were based on univariate models would therefore err in inferring the structural change of the estimated processes. We conclude that allowing unobservables to be correlated across equations is a major ingredient of the empirical model and not only statistically, but also economically important.[19]

6.2 Sensitivity Checks

We have performed a series of checks to see if our main specification stays robust to changes in specification, and we used a linear model that allows assessing the assumptions underlying the random effects specification by means of statistical testing.

One of the salient results of the above analysis is that (log) wealth does not have any impact on the self–employment process. This result is surprising in light of the literature so far, but in line with findings of Hurst and Lusardi (2002). These authors suggested estimating a flexible (5th order) polynomial in wealth to detect any nonlinearities. Our results do not change when we add higher–order terms of $y_{W,t-1}$ in the self–employment equation. None of the polynomial coefficients were statistically or economically relevant.

Second, we tried to estimate the model in wealth levels (instead of logs) without any success (non–convergence). This suggests that the skewness of the dependent variable wealth is a major impediment to estimating models such as ours in levels.

Third, we also allowed additional support points in the bivariate distribution of the random effects. Again, the model would not converge, which is suggestive of the data not being able to discriminate between further support points, and the current specification being sufficiently rich to capture the variation in the data.

Fourth, we checked if the definition of self–employment, as detailed in Section 3 changes the main conclusions. Excluding the category "director or (main) share holder of a private limited company" from the pool of self–employed resulted in fairly similar estimates, however.

Fifth, we followed the approach advocated by Alessie *et al.* (2001) and employed a Simulated Maximum Likelihood estimator, where the random

[19]The reported likelihood values are only indicative of a formal LR test, since the results of the univariate models were not generated from a restricted version of the bivariate model. The correct inference should therefore be drawn on the bases of $t-$tests on the estimated random effects correlation in the bivariate models.

effects are assumed to follow a bivariate normal distribution. Even though it was possible to estimate univariate models, in the bivariate model the correlation coefficients would not move away from zero during iteration.

Sixth, using the just mentioned alternative estimator, we also included an interaction term between $y_{S,t-1}$ and $y_{W,t-1}$ in both equations. None of them turned out statistically or economically significant. Neither did interactions between either $y_{S,t-1}$ or $y_{W,t-1}$ and regressors $\boldsymbol{x}$.

Seventh, and perhaps most importantly, we used a GMM estimator in (univariate) linear models that explicitly allow testing the assumptions underlying the random effects estimator of uncorrelatedness of error components and regressors $\boldsymbol{x}$. The estimates are displayed in Tables 10 and 11 for financial assets and total personal net worth, respectively.[20]

[**Table 10 about here**]

[**Table 11 about here**]

We select specifications that imitate the random effects model in the sense that they rest on comparable assumptions. In particular, we assume that

1. there is no correlation between time–invariant regressors and either the random effects or the error terms

2. there is no correlation between time–varying regressors and either the random effects or the error terms

3. both processes of wealth accumulation and self–employment are mean stationary (that is, first–differenced endogenous variables are uncorrelated with the error terms in levels)

The results are based on two–stage estimates, and standard errors are robust to heteroskedasticity.[21] A comparison between Tables 10 and 7 reveals that the main conclusions about the interaction of self–employment and wealth holding are qualitatively unaffected. The magnitudes of coefficients, in particular in the financial assets equation, change somewhat, however. Note that a direct comparison of coefficient magnitudes in the self–employment equation is precluded due to the nonlinearity of the probit model. Again, we find that many of the covariates do not significantly affect the self–employment or the wealth process. Where significant effects are found, they point in the same direction as in the random effects model.

[20] Again, time dummies are included but suppressed in the Table for brevity.

[21] We make use of the DPD98 software of Arellano and Bond (1998).

The qualitative similarity between these two types of models is therefore reassuring (bearing in mind that the number of observations is different).

Similar remarks apply to a comparison between Tables 11 and 8. Again, we notice that the change in parameters between the financial assets specification and the net worth specification is in the same direction as we observed already in comparing both specifications of the random effects model. Therefore, we do not further discuss the estimated coefficients in more depth.

We wish to note, though, that the imposed moment conditions are not rejected. Two types of specification tests are employed, a Sargan test on the over–identifying restrictions, and tests on first and second order autocorrelation in the residuals of the differenced equations. The Sargan test statistics for the self–employment and the financial assets equations have $p-$values of 0.128 and 0.186, respectively. The AR(2) tests have $p-$values of 0.074 and 0.890, respectively. Using net worth instead, we find Sargan tests with $p-$values of 0.125 and 0.289, respectively, and AR(2) tests with $p-$values of 0.051 and 0.624, respectively.

We have also done a sensitivity analysis concerning the specification and moment restrictions. The final selection was made on basis of the aforementioned specification tests. It appears that conditioning on average regressor values is necessary. This is supposed to attenuate a possible correlation between the individual effects and the time–varying regressors. Indeed, in specifications where these average values are included, it does not make a lot of a difference whether moment restrictions implied by the assumption of uncorrelatedness are imposed or not. This is true for both equations. Relaxing the assumption of mean stationarity on the other hand (in addition to not imposing uncorrelatedness of time–varying regressors and individual effects), *does* make a difference for the self–employment equation—here the assumption of no second–order serial correlation in the differenced equations is actually rejected. In all other specifications this assumption could not be rejected.

In sum, we can conclude that there is not much (indirect) evidence against the specifications in our random effects models.

7 Conclusions

to be completed.

Readers of this preliminary draft are kindly requested not to quote the paper at the present stage. Please contact the author for requesting updates.

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Tables

Table 1: Self–employment Rates (weighted)

year	rate (%)
1993	5.96
1994	7.00
1995	7.55
1996	8.48
1997	7.91
1998	5.52

Table 2: Transition Rates (unweighted)

years $t/t+s$	entries	stayers	exits
1993/94	4.5	89.7	10.3
	(1392)	(87)	(87)
1994/95	1.6	86.6	13.4
	(1165)	(97)	(97)
1995/96	1.9	84.9	15.1
	(1006)	(99)	(99)
1996/97	1.6	86.3	13.7
	(801)	(80)	(80)
1997/98	0.6	83.3	16.7
	(524)	(42)	(42)
total	2.4	86.0	14.0
	(5014)	(381)	(381)
1993/97	5.7	81.8	18.2
	(423)	(22)	(22)

Note: entries: as percentage of previously not self–employed; stayers and exits: as percentage of previously self–employed. Total cell sizes (corresponding to 100%) in parentheses.

Table 3: Wealth Holding of Self–employed and Non–Self–employed

year		STCKS1	STCKS2	FINASS	FINDBT	TPNETW	BUSEQU	HOUSEQ	HOME%
									Non-Self-Employed
1993	mean	4276	3786	47414	9248	121339	4202	69864	47.0
	median	0	0	15250	50	47841	0	0	
1994	mean	2733	2584	41597	7536	109715	1319	64172	46.1
	median	0	0	12161	0	38136	0	0	
1995	mean	2602	2510	43405	8114	115726	477	68665	47.0
	median	0	0	13646	0	46554	0	0	
1996	mean	3716	3363	49402	8038	130682	532	77041	48.8
	median	0	0	16665	47	56531	0	0	
1997	mean	4110	4074	48820	7461	137597	566	83665	48.3
	median	0	0	16715	44	60072	0	0	
1998	mean	4398	4398	53157	7670	147875	2811	90621	49.9
	median	0	0	21813	0	76583	0	0	
									Self-Employed
1993	mean	195316	23691	337710	34326	491579	168262	161931	63.7
	median	0	0	81403	580	198389	40001	75000	
1994	mean	139661	17687	291030	27103	496554	195195	210705	73.1
	median	0	0	93822	1044	238283	47706	122501	
1995	mean	121869	14526	261323	18264	495919	217976	237339	69.5
	median	0	0	88916	0	231816	41957	114824	
1996	mean	156324	49099	272654	18623	435762	221067	164280	62.8
	median	0	0	57848	47	196373	40930	93023	
1997	mean	83560	51204	205230	28432	430958	195808	233095	69.7
	median	0	0	91705	1367	256155	62509	145852	
1998	mean	96213	70336	176026	9324	390531	170084	208243	72.2
	median	0	0	37269	0	238155	80501	149629	
									All
1993	mean	15685	4975	64821	10745	143539	14000	75385	48.0
	median	0	0	16115	50	51851	0	0	
1994	mean	12287	3637	59062	8902	136801	14846	74432	48.0
	median	0	0	13336	0	46759	0	0	
1995	mean	11661	3423	59990	8885	144662	16997	81502	48.7
	median	0	0	15390	0	53879	0	0	
1996	mean	16636	7235	67955	8934	156036	19202	84291	49.9
	median	0	0	18327	47	61767	0	0	
1997	mean	10426	7821	61261	9128	160930	16086	95550	50.0
	median	0	0	18786	46	67386	0	0	
1998	mean	9484	8050	59771	7761	160936	12076	96952	51.1
	median	0	0	22345	0	78474	0	894	

Table 4: Changes in Wealth Holding of Self–employed and Non–Self–employed

year		STCKS1	STCKS2	FINASS	FINDBT	TPNETW	BUSEQU	HOUSEQ
Non-Self-Employed								
1994	mean	-795	272	129	-705	-1823	-4095	-2100
	median	0	0	0	0	-627	0	0
1995	mean	-1225	779	-1332	454	2650	-2180	4142
	median	0	0	286	0	2253	0	0
1996	mean	-2159	-382	868	211	10371	-1188	9448
	median	0	0	464	0	2476	0	0
1997	mean	952	927	2253	-1863	17354	-1640	12347
	median	0	0	0	0	2742	0	0
1998	mean	1556	1594	8066	302	18333	20	9932
	median	0	0	909	0	2403	0	0
Self-Employed								
1994	mean	28785	1542	35326	-7409	64801	84853	25594
	median	0	0	2592	0	7440	1213	-2724
1995	mean	4292	696	-665	-10776	5669	35009	-1799
	median	0	0	3117	0	8965	0	0
1996	mean	53666	11585	55725	-7220	63361	27331	-2317
	median	0	0	3286	0	31298	0	0
1997	mean	27922	45250	43921	3826	107432	82276	67903
	median	0	0	2759	0	27881	0	0
1998	mean	10759	9098	-40535	-1990	-67358	-8387	-29224
	median	0	0	444	0	9661	0	10420
All								
1994	mean	1458	369	2822	-1216	3275	2679	19
	median	0	0	0	0	-520	0	0
1995	mean	-839	773	-1285	-333	2863	423	3724
	median	0	0	305	0	2364	0	0
1996	mean	2589	635	5417	-421	14764	1238	8473
	median	0	0	563	0	3168	0	0
1997	mean	3180	4588	5625	-1393	24645	5292	16844
	median	0	0	20	0	3170	0	0
1998	mean	2171	2096	4914	149	12776	-542	7393
	median	0	0	901	0	2499	0	0

This Table shows changes in wealth by employment status in various wealth categories. '1994' means: change in wealth between 1994 and 1993, etc.

Table 5: Wealth and Changes in Wealth of Business Starters

year	STCKS1	STCKS2	FINASS	FINDBT	TPNETW	BUSEQU	HOUSEQ	N
							Wealth (t)	
1994	0	0	59753	49	205350	55260	108949	63
1995	0	0	74125	0	161645	53603	66225	21
1996	0	0	24952	0	141242	34215	76374	19
1997	0	0	33981	2464	156257	143164	45579	13
1998	984	984	75270	332	355764	44723	187835	4
							Changes in Wealth (t)	
1994	0	0	2592	0	5555	37307	-2233	63
1995	0	0	17806	0	42402	28208	8186	21
1996	0	0	3286	0	5874	17528	0	19
1997	0	0	27981	0	27881	143164	0	13
1998	100	100	32212	332	175896	44723	41921	4
							Wealth (t-1)	
1994	0	0	53714	200	207268	0	148961	63
1995	0	0	45401	0	101803	0	72957	21
1996	0	0	22006	0	127526	0	94607	19
1997	0	0	13302	47	70291	0	27907	13
1998	0	0	3551	0	166665	0	159526	4
							Changes in Wealth (t-1)	
1995	0	0	812	0	-577	0	-5175	14
1996	0	0	-1668	0	21167	0	0	12
1997	0	0	-1	0	5823	0	0	11
1998	0	0	-17779	-11163	3968	0	-4086	4

This Table displays median wealth and wealth changes of entrants. Entrants transit into self-employment from the previous year. Wealth (t) corresponds to the numbers in Table 3, saving (t) to Table 4. Wealth (t-1) and saving (t-1) are each lagged by an additional period: '1995' means: wealth holding in 1994 and saving between 1994 and 1993 of those that became self-employed between 1994 and 1995. N=sample size.

Table 6: Sample Characteristics by Employment Status, 1993 (weighted)

	non-self-employed		self-employed	
	mean	stdv.	mean	stdv.
intermed. education	0.102	0.303	0.150	0.358
vocational education	0.548	0.498	0.478	0.502
high education	0.191	0.393	0.195	0.398
age	39.488	10.332	42.710	10.015
female	0.245	0.430	0.165	0.372
couple	0.686	0.464	0.823	0.383
divorced/widowed	0.100	0.300	0.054	0.228
expect inheritance	0.115	0.320	0.178	0.384
exp. inh. don't know	0.148	0.355	0.154	0.363
exp. inh. not avail.	0.098	0.297	0.121	0.328
log (income+1)	10.154	2.990	4.600	5.349
HH marg. tax rate	0.425	0.157	0.411	0.207
high-income panel	0.259	0.438	0.565	0.498
low risk aversion	0.090	0.287	0.050	0.218
interm. risk avers.	0.312	0.463	0.342	0.476
risk av. don't know	0.065	0.247	0.000	0.000
risk av. not avail.	0.241	0.428	0.283	0.452

Table 7: Estimation Results, Financial Assets, RE Model (ML)

N HH=1776 Nobs=5538

regressor	SELF-EMPLOYED estimate	SELF-EMPLOYED stderr	FIN.ASSETS estimate	FIN.ASSETS stderr
intercept	-9.914	0.717***	3.202	0.224***
self-empl. [-1]	2.771	0.136***	0.251	0.091***
log fin.ass.[-1]	0.034	0.038	0.543	0.010***
edu: intermed.	0.079	0.309	-0.014	0.096
edu: vocational	-0.070	0.215	0.026	0.071
edu: high	-0.073	0.243	0.104	0.094
[Wald:p-value]	0.91811		0.59876	
age	0.007	0.007	0.011	0.003***
female	-0.251	0.269	0.103	0.079
couple	0.149	0.275	0.068	0.078
divorced/wid.	0.085	0.413	-0.262	0.106**
[Wald:p-value]	0.86179		0.00062	
log (income+1)	-0.086	0.031***	0.035	0.021
hh marg. tax r.	1.194	0.809	0.494	0.356
high-inc. panel	0.322	0.162**	0.383	0.067***
[Wald:p-value]	0.00532		0.00000	
risk av.: low	0.212	0.248	-0.104	0.075
risk av.: interm.	0.221	0.133*	0.022	0.046
risk av.: DK	0.010	0.541	-0.333	0.080***
[Wald:p-value]	0.38787		0.00005	
avg. log income	-0.193	0.040***	-0.052	0.026*
avg. marg. tax r.	0.998	0.822	1.528	0.472***
[Wald:p-value]	0.00001		0.00344	
variance RE	1.136	0.283***	0.266	0.059***
sigma epsilon	1	-----	1.134	0.007***
correl RE	0.287	0.096***		
correl epsilon	0.196	0.052***		
LL	-9696.75			

Table 8: Estimation Results, Net Worth, RE Model (ML)

N HH=1776 Nobs=5538

regressor	SELF-EMPLOYED estimate	SELF-EMPLOYED stderr	NET WORTH estimate	NET WORTH stderr
intercept	-18.277	0.863***	5.818	0.666***
self-empl. [-1]	2.762	0.137***	1.036	0.295***
log net wth.[-1]	0.000	0.052	0.152	0.009***
edu: intermed.	0.124	0.361	0.457	0.252*
edu: vocational	-0.051	0.279	0.162	0.178
edu: high	-0.015	0.292	0.178	0.220
[Wald:p-value]	0.91201		0.34936	
age	0.007	0.008	0.029	0.008***
female	-0.279	0.273	0.060	0.258
couple	0.049	0.262	0.490	0.194**
divorced/wid.	0.008	0.410	-0.465	0.265*
[Wald:p-value]	0.97985		0.00005	
log (income+1)	-0.084	0.030***	0.002	0.065
hh marg. tax r.	1.135	0.783	2.212	1.076**
high-inc. panel	0.351	0.171**	0.466	0.160***
[Wald:p-value]	0.00368		0.00265	
risk av.: low	0.248	0.242	0.060	0.219
risk av.: interm.	0.228	0.139	-0.107	0.132
risk av.: DK	0.064	0.591	-0.218	0.242
[Wald:p-value]	0.38233		0.63690	
avg. log income	-0.209	0.040***	0.008	0.089
avg. marg. tax r.	1.059	0.808	1.071	1.414
[Wald:p-value]	0.00000		0.69900	
variance RE	16.513	2.818***	9.321	1.084***
sigma epsilon	1	-----	2.842	0.018***
correl RE	0.510	0.066***		
correl epsilon	0.089	0.081		
LL	-14006.06			

Table 9: Comparison with Univariate Models

regressor	SELF-EMPLOYED estimate	SELF-EMPLOYED stderr	FIN.ASSETS estimate	FIN.ASSETS stderr
--- univariate ---				
self-empl. [-1]	1.739	0.219***	0.251	0.078***
log fin.ass.[-1]	0.055	0.045	0.540	0.010***
LL	-641.70		-9392.01	
--- bivariate ---				
self-empl. [-1]	2.771	0.136***	0.251	0.091***
log fin.ass.[-1]	0.034	0.038	0.543	0.010***
LL	-9696.75			

regressor	SELF-EMPLOYED estimate	SELF-EMPLOYED stderr	NET WORTH estimate	NET WORTH stderr
--- univariate ---				
self-empl. [-1]	1.784	0.215***	0.459	0.231**
log net wrth[-1]	0.018	0.021	0.177	0.010***
LL	-641.78		-14481.87	
--- bivariate ---				
self-empl. [-1]	2.762	0.137***	1.036	0.295***
log net wth.[-1]	0.000	0.052	0.152	0.009***
LL	-14006.06			

Table 10: Estimation Results, Financial Assets, Linear FE Model (GMM)

N HH=1021 Nobs=4028

	SELF-EMPLOYED		FIN.ASSETS	
regressor	estimate	stderr	estimate	stderr
intercept	0.465	0.063***	5.166	0.503***
self-empl. [-1]	0.399	0.067***	0.580	0.248***
log fin ass.[-1]	0.003	0.002	0.174	0.040***
edu: intermed.	0.005	0.005	-0.120	0.169
edu: vocational	-0.001	0.003	0.016	0.118
edu: high	-0.004	0.011	0.242	0.137*
age	-0.000	0.000	0.024	0.004***
female	-0.010	0.007	0.118	0.100
couple	0.013	0.010	0.129	0.137
divorced/wid.	0.009	0.010	-0.412	0.218*
log (income+1)	-0.009	0.005*	0.033	0.029
hh marg. tax r.	0.034	0.059	0.176	0.335
high-inc. panel	0.027	0.011**	0.563	0.094***
avg. log income	-0.049	0.008***	-0.044	0.036
avg. marg. tax r.	0.315	0.092***	4.050	0.656***
risk av.: low	-0.000	0.008	-0.050	0.099
risk av.: interm.	0.001	0.005	0.028	0.044
risk av.: DK	-0.002	0.009	-0.477	0.153***
Sargan test: p-val.	0.128		0.186	
AR(1) test: p-val.	0.002		0.000	
AR(2) test: p-val.	0.074		0.890	

Table 11: Estimation Results, Net Worth, Linear FE Model (GMM)

N HH=1021 Nobs=4028

regressor	SELF-EMPLOYED estimate	SELF-EMPLOYED stderr	NET WORTH estimate	NET WORTH stderr
intercept	0.454	0.062***	1.147	1.187
self-empl. [-1]	0.434	0.070***	1.228	0.362***
log net wrth[-1]	0.000	0.000	0.074	0.035**
edu: intermed.	0.005	0.006	0.094	0.364
edu: vocational	0.000	0.003	0.365	0.355
edu: high	-0.002	0.011	0.117	0.386
age	-0.000	0.000	0.065	0.011***
female	-0.011	0.008	0.019	0.159
couple	0.011	0.009	0.838	0.358**
divorced/wid.	0.009	0.010	-0.521	0.610
log (income+1)	-0.007	0.006	-0.025	0.061
hh marg. tax r.	-0.001	0.055	1.079	0.858
high-inc. panel	0.024	0.010**	0.448	0.182**
avg. log income	-0.048	0.009***	0.092	0.084
avg. marg. tax r.	0.371	0.086***	7.625	1.960***
risk av.: low	-0.001	0.008	0.089	0.247
risk av.: interm.	0.004	0.006	-0.137	0.133
risk av.: DK	-0.003	0.008	-0.349	0.329
Sargan test: p-val.	0.125		0.289	
AR(1) test: p-val.	0.001		0.000	
AR(2) test: p-val.	0.051		0.624	

A Estimation of Random Effects Model

A.1 Likelihood Function

To repeat, the main equations of interest are specified as follows:

$$y^{\star}_{St} = \mu_{St} + u_{St} = \boldsymbol{x}'_t \beta_S + y_{S,t-1}\gamma_{SS} + y_{W,t-1}\gamma_{SW} + \alpha_S + u_{St} \quad \text{(A.1)}$$
$$y^{\star}_{Wt} = \mu_{Wt} + u_{Wt} = \boldsymbol{x}'_t \beta_W + y_{S,t-1}\gamma_{WS} + y_{W,t-1}\gamma_{WW} + \alpha_W + u_{Wt} \quad \text{(A.2)}$$

for $t = 2, \ldots, T$, household index i suppressed. The first observation (initial conditions) equation is written as:

$$y^{\star}_{S1} = \mu_{S1} + \varepsilon_{S1} = \boldsymbol{x}'_1 \kappa_S + \lambda_{SS}\alpha_S + \lambda_{SW}\alpha_W + \varepsilon_S \quad \text{(A.3)}$$
$$y^{\star}_{W1} = \mu_{W1} + \varepsilon_{W1} = \boldsymbol{x}'_1 \kappa_W + \lambda_{WS}\alpha_S + \lambda_{WW}\alpha_W + \varepsilon_W \quad \text{(A.4)}$$

The S equation is a binary choice model, the W equation is continuous:

$$y_{St} = \begin{cases} 1 & \text{if } y^{\star}_{St} > 0 \\ 0 & \text{else} \end{cases} \quad \text{(A.5)}$$
$$y_{Wt} = y^{\star}_{Wt} \qquad t = 1, \ldots, T \quad \text{(A.6)}$$

We will be assuming that

$$\begin{pmatrix} u_S \\ u_W \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho\sigma_W \\ \rho\sigma_W & \sigma^2_W \end{pmatrix} \right) \quad \text{(A.7)}$$

and

$$\begin{pmatrix} \varepsilon_S \\ \varepsilon_W \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_\varepsilon\sigma_\varepsilon \\ \rho_\varepsilon\sigma_\varepsilon & \sigma^2_\varepsilon \end{pmatrix} \right) \quad \text{(A.8)}$$

which renders the S equation a probit equation. Now, the above structure implies that the involved bivariate probabilities will be of the form

$$P^-_t = f(y_{Wt} = y^{\star}_{Wt}) \cdot \Pr(y^{\star}_{St} \leq 0 | y_{Wt} = y^{\star}_{Wt}) \quad \text{or} \quad \text{(A.9)}$$
$$P^+_t = f(y_{Wt} = y^{\star}_{Wt}) \cdot \Pr(y^{\star}_{St} > 0 | y_{Wt} = y^{\star}_{Wt}) \quad \text{(A.10)}$$

These probabilities are functions of the random effects α_j. Joint normality of both u_j and ε_j implies normality of both marginal and conditional densities, such that the above become

$$P^{\pm}_t = \frac{1}{\sigma_W}\phi(\hat{y}_{Wt}) \cdot \Phi\left(\pm\hat{\mu}_{St}\right) \quad \text{(A.11)}$$

(and, accordingly for $P^{\pm}_1$ with ρ and σ_W replaced with ρ_ε and σ_ε, respectively). Here, $\hat{y}_W$ is the standardized version of y_W (using σ_W and μ_{Wt} or σ_ε and μ_{W1}, respectively), and

$$\hat{\mu}_{S1} = \frac{\mu_{S1} + \rho_\varepsilon \hat{y}_{W1}}{\sqrt{1-\rho^2_\varepsilon}}; \qquad \hat{\mu}_{St} = \frac{\mu_{St} + \rho\hat{y}_{Wt}}{\sqrt{1-\rho^2}}, \quad t = 2, \ldots, T \quad \text{(A.12)}$$

We postulate the random effects to follow a discrete bivariate distribution such that each of them can take only two values. We then have four probabilities p_{ij}:

		α_S	
		α_S^1	α_S^2
α_W	α_W^1	p_{11}	p_{12}
	α_W^2	p_{21}	p_{22}

Furthermore, we specify $p_{ij} = \frac{\exp\{\delta_{ij}\}}{\sum_k \sum_l \exp\{\delta_{kl}\}}$, where $\delta_{11} = 0$, in order to guarantee estimated probabilities to lie in the $(0,1)$ interval and add to unity. Since the equations contain intercepts, we also need to restrict the location of the distribution of the α's, and choose $\alpha_S^1 = \alpha_W^1 = 0$. That means, there are in total five free parameters to be estimated (3 δ's and 2 α–constants). The initial conditions equations are then rewritten as

$$y_{S1}^{\star,(k,l)} = \mu_{S1} + \varepsilon_{S1} = \boldsymbol{x}_1'\kappa_S + \lambda_{SS}\alpha_S^k + \lambda_{SW}\alpha_W^l + \varepsilon_S \tag{A.13}$$

$$y_{W1}^{\star,(k,l)} = \mu_{W1} + \varepsilon_{W1} = \boldsymbol{x}_1'\kappa_W + \lambda_{WS}\alpha_S^k + \lambda_{WW}\alpha_W^l + \varepsilon_W \tag{A.14}$$

The likelihood function then becomes

$$f = \sum_{\tau=1}^{T} \ln B_\tau \qquad B_\tau = \sum_k \sum_l p_{kl} P_\tau^{\pm,(k,l)} \tag{A.15}$$

where $P_\tau^{\pm,(k,l)}$ is (A.11) in which the α_j are replaced with one of the four regime–specific constants α_j^i from the above table. The model can be extended in obvious ways to allow for more than two support points per dimension.

A.2 Gradient

Let θ be one of the model parameters. We shall then have to determine the first derivative of (A.15) with respect to each θ, which is one of the following:

- coefficients initial condtions: κ_{kj} (intercept and slopes), $\lambda_{SS} \ldots \lambda_{WW}$ (auxiliary coefficients)
- distributional parameters initial condtions: ρ_ε and σ_ε
- coefficients main equations: β_{kj} (intercept and slopes), $\gamma_{SS} \ldots \gamma_{WW}$ (lagged endogenous variables)
- distributional parameters error terms u_j: ρ and σ_W
- random effects: α_S^2, α_W^2, and parameters of associated probabilities, δ_{12}, δ_{21}, and δ_{22}.

The gradient is of the form

$$\frac{\partial f}{\partial \theta} = \sum_{\tau=1}^{T} \frac{1}{B_\tau} \sum_k \sum_l \left\{ \frac{\partial p_{kl}}{\partial \theta} P_\tau^{\pm,(k,l)} + p_{kl} \frac{\partial P_\tau^{\pm,(k,l)}}{\partial \theta} \right\} \tag{A.16}$$

Note that the p_{kl}'s are functions of the three δ's only, so that most of the $\frac{\partial p_{kl}}{\partial \theta}$ will be zero. Conversely, $P_\tau^{\pm,(k,l)}$ does not depend on the δ's, but only on other parameters in θ.

$$\begin{aligned}
\frac{\partial p_{ij}}{\partial \delta_{ij}} &= \frac{\exp\{\delta_{ij}\}((\sum_k \sum_l \exp\{\delta_{kl}\}) - \exp\{\delta_{ij}\})}{(\sum_k \sum_l \exp\{\delta_{kl}\})^2} = p_{ij}(1-p_{ij}) \\
\frac{\partial p_{ij}}{\partial \delta_{gh}} &= -\left(\frac{\exp\{\delta_{gh}\}}{\sum_k \sum_l \exp\{\delta_{kl}\}}\right)^2 = -p_{gh}^2
\end{aligned}$$

The derivatives of $P_\tau^{\pm,(k,l)}$ are[22]

$$\begin{aligned}
\frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{0S}} &= \pm\frac{1}{\sigma_\varepsilon}\phi(\hat{y}_{W1})\phi(\pm\hat{\mu}_{S1})\frac{1}{\sqrt{1-\rho_\varepsilon^2}} \\
\frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{kS}} &= \frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{0S}} \times x_{k,t} \\
\frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{0W}} &= \frac{1}{\sigma_\varepsilon^2}\phi(\hat{y}_{W1})\left[\Phi(\pm\hat{\mu}_{S1})\hat{y}_{W1} \mp \phi(\pm\hat{\mu}_{S1})\frac{\rho_\varepsilon}{\sqrt{1-\rho_\varepsilon^2}}\right] \\
\frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{kW}} &= \frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{0W}} \times x_{k,t} \\
\frac{\partial P_1^{\pm,(k,l)}}{\partial \lambda_{SW}} &= \frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{0S}} \times \alpha_W^{(k,l)} \\
\frac{\partial P_1^{\pm,(k,l)}}{\partial \lambda_{WS}} &= \frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{0W}} \times \alpha_S^{(k,l)} \\
\frac{\partial P_1^{\pm,(k,l)}}{\partial \rho_\varepsilon} &= \frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{0S}} \times \left(\hat{\mu}_{S1}\frac{\rho_\varepsilon}{\sqrt{1-\rho_\varepsilon^2}} + \hat{y}_{W1}\right) \\
\frac{\partial P_1^{\pm,(k,l)}}{\partial \sigma_\varepsilon} &= \frac{\partial P_1^{\pm,(k,l)}}{\partial \kappa_{0W}}\hat{y}_{W1} - \frac{1}{\sigma_\varepsilon^2}\phi(\hat{y}_{W1})\Phi(\pm\hat{\mu}_{S1}) \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0S}} &= \pm\frac{1}{\sigma_W}\phi(\hat{y}_{Wt})\phi(\pm\hat{\mu}_{St})\frac{1}{\sqrt{1-\rho^2}} \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{kS}} &= \frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0S}} \times x_{k,t} \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0W}} &= \frac{1}{\sigma_W^2}\phi(\hat{y}_{Wt})\left[\Phi(\pm\hat{\mu}_{St})\hat{y}_{Wt} \mp \phi(\pm\hat{\mu}_{St})\frac{\rho}{\sqrt{1-\rho^2}}\right] \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{kW}} &= \frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0W}} \times x_{k,t}
\end{aligned}$$

[22] a zero subscript on parameters κ and β denotes the constant term

$$
\begin{aligned}
\frac{\partial P_t^{\pm,(k,l)}}{\partial \gamma_{SW}} &= \frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0S}} \times y_{W,t-1} \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \gamma_{WS}} &= \frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0W}} \times y_{S,t-1} \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \rho} &= \frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0S}} \times \left(\hat{\mu}_{St} \frac{\rho}{\sqrt{1-\rho^2}} + \hat{y}_{Wt} \right) \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \sigma_W} &= \frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0W}} \hat{y}_{Wt} - \frac{1}{\sigma_W^2} \phi(\hat{y}_{Wt}) \Phi(\pm \hat{\mu}_{St}) \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \alpha_S^{(k,l)}} &= \frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0S}} \\
\frac{\partial P_t^{\pm,(k,l)}}{\partial \alpha_W^{(k,l)}} &= \frac{\partial P_t^{\pm,(k,l)}}{\partial \beta_{0W}}
\end{aligned}
$$

B Linear Model

This appendix presents standard linear dynamic panel data models that can be estimated by the General Method of Moments.[23] We distinguish two types of covariates: $\boldsymbol{x}_t = (\boldsymbol{x}_t^1, \boldsymbol{x}^2)$, where $\boldsymbol{x}_t^1$ are time varying and (strictly) exogenous, and $\boldsymbol{x}^2$ are time invariant.[24] The model has the same structural equations as (1), (2), and (4), except that the binary choice relation (3) will be replaced with the linear probability assumption, hence

$$
y_{St} = y_{St}^{\star} \qquad t = 1, \ldots, T \tag{B.1}
$$

We make the following assumptions:

1. $\{\boldsymbol{x}_t^1; t = 1, \ldots, T\}$ uncorrelated to $\{(u_{St}, u_{Wt});\ t = 1, \ldots, T\}$ (strict exogeneity)
2. $\boldsymbol{x}^2$ uncorrelated to α_S and α_W and to $\{(u_{St}, u_{Wt});\ t = 1, \ldots, T\}$
3. $\{u_t, t = 1, \ldots, T\}$ are mutually uncorrelated.

The assumption on the time invariant regressors is in line with a Hausman–Taylor (1981) approach. Not considering any time invariant regressors at all would correspond to the common practice of not using time invariant regressors in a fixed effects model.

[23] The exposition draws on Alessie *et al.* (2001).

[24] In the empirical part, $\boldsymbol{x}^2$ will also include some variables that only vary systematically over time, such as age.

Define, for $t = 3, \ldots, T$,

$$\epsilon_{St} = y_{St} - [\boldsymbol{x}'_t\beta_S + y_{S,t-1}\gamma_{SS} + y_{W,t-1}\gamma_{SW}](= \alpha_S + u_{St}) \quad \text{(B.2)}$$
$$\epsilon_{Wt} = y_{Wt} - [\boldsymbol{x}'_t\beta_W + y_{W,t-1}\gamma_{WS} + y_{W,t-1}\gamma_{WW}](= \alpha_W + u_{Wt}) \quad \text{(B.3)}$$

and

$$\Delta\epsilon_{jt} = \epsilon_{jt} - \epsilon_{j,t-1}(= u_{jt} - u_{j,t-1});\ j = S, W. \quad \text{(B.4)}$$

The model assumptions imply the following moments

- $\mathrm{E}[\Delta\boldsymbol{x}^1_s\Delta\epsilon_{jt}] = 0;\ j = S, W; s = 2, \ldots, T;\ t = 3, \ldots, T$ (strict exogeneity)
- $\mathrm{E}[y_{is}\Delta\epsilon_{jt}] = 0;\ i, j = S, W;\ s = 1, \ldots, t-2;\ t = 3, \ldots, T$ (lagged dependent variables)
- $\mathrm{E}[\boldsymbol{x}^2\epsilon_{jt}] = 0;\ j = S, W;\ t = 3, \ldots, T$ (time invariant regressors)

It is well–known that the small sample performance of GMM can deteriorate if many moments are used. To avoid this problem, we will only use the following moments, in which regressors and error terms are "as close as possible":

- $\mathrm{E}[\Delta\boldsymbol{x}^1_t\Delta\epsilon_{jt}] = 0;\ j = S, W;,\ t = 3, \ldots, T$ ((strict) exogeneity)
- $\mathrm{E}[y_{i,t-2}\Delta\epsilon_{jt}] = 0;\ j = S, W;,\ t = 3, \ldots, T$ (lagged dependent variables)
- $\mathrm{E}[\boldsymbol{x}^2\epsilon_{jt}] = 0;\ j = S, W;\ t = 3, \ldots, T$ (time invariant regressors)

For a given specification, i.e., given choices of $\boldsymbol{x}^1_t$ and $\boldsymbol{x}^2$, these moments can be used for standard GMM estimation, separately for both equations. Any type of heteroskedasticity is allowed for, including that implied by the binary nature of the dependent variable. Sargan tests for overidentifying restrictions are used to test the validity of the moment restrictions. The assumption that the errors u_{jt} are uncorrelated error terms seems quite strong, but is common in this type of model. This assumption will be tested by checking for second order autocorrelation in the residuals in the differenced equations.