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Modelling Business Ownership in the Netherlands

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Contents

1 Summary

Introduction

There is a substantial interest, in science as well as in policy circles, to understand the resurgence of business ownership (or, equivalently, entrepreneurship[1]), which has occurred in the Netherlands in recent years. A major question is whether the number of business owners will keep rising in the coming years. The analysis is complex because the number of business owners must be viewed from the perspective of both the labour market (*supply side of entrepreneurship*) and the product market (*demand side of entrepreneurship*). Demand and supply of entrepreneurship, as well as the (possibility of) equilibrium, depend on cultural, technological, economic and regulatory factors. Therefore, many determinants have to be considered.

For economic policy it is also important to know the rates of gross entry and exit. A high level of turbulence (the sum of gross entry and exit) is associated with highly competing markets. Increasing competition is one of the main policies of the Dutch government, as more competition is believed to stimulate economic growth.

At the aggregate level econometric modelling seems to be a suitable approach to the problem at hand (see Wennekers, 1999). It enables us to specify measurable relationships and to study the dynamics involved. Moreover, modelling will help us to better understand past performance and to foresee possible future developments.

This paper describes a model designed to explain the observed developments of the business ownership rate as well as gross entry and exit rates. Besides explaining the past, the model is used for exploring the future using scenario analysis.

Modelling

Business ownership can be viewed from a static and from a dynamic perspective. The static or long-run approach focuses on explaining the equilibrium number of business owners, or equivalently the percentage of business owners in the labour force (the business ownership rate). The dynamic or short-run approach considers the

1 We use the terms business ownership and entrepreneurship interchangeably; both are understood to include unincorporated businesses as well as the owner/manager of incorporated businesses.

actual changes in the business ownership rate (net entry), as well as gross entry, exit and the sum of entry and exit (turbulence).

Cointegration is used to simultaneously investigate the long-run and the short-run developments of the business ownership rate. The long-run equation investigates the percentage of self-employment in the labour force, whereas the short-run equation models the annual change of this percentage. An error correction mechanism gears the short-run business ownership rate towards the long run. Cointegration analysis acknowledges the stochastic trends of the time series, provided that these time series satisfy some criteria. Consequences of these criteria are that the number of determinants to be included in the long-run equation is limited and that determinants that have deviant stochastic characteristics cannot be included.

Application to the Netherlands

The long-run equation

The long-run (equilibrium) business ownership rate in our model is explained by income differences and a sector structure characteristic, which sets out the number of employees in services against the number of employees in manufacturing and thus measures the trend of increasing demand for services.

Income differences are assumed to affect both the supply side and the demand side. A relatively large group having high incomes implies the availability of financial means to start a business. Conversely, the group having low incomes may be pushed to start a business. Income differences may also influence the demand side of entrepreneurship because higher income differences cause more differentiated consumer demands and thus more room for entrepreneurship. Finally, a high share of services is expected to stimulate business ownership.

The short-run equation

The short-run equation considers the annual changes of the business ownership rate. Apart from the determinants that already appeared in the long-run equation (income differences and the sector structure), unemployment rates and the profit share in production enter the equation. It is found that a high level of unemployment will lead to an increase in business ownership in the short run. Higher profitability is more attractive to the business owner, and a positive relation is found between the profit share and the change in the business ownership rate. The third additional determinant for explaining the net entry rate is the share of middle-aged people[1]. The error correction mechanism predicts that a deviation of the actual business ownership rate with respect to the equilibrium rate is adjusted for by 30 percent in two years.

Including gross entry and exit

We have added an equation explaining the turbulence of businesses – defined as the sum of entry and exit – to the model. We chose not to model entry and exit directly as is usually done. Simultaneity and symmetry typically appear in these kinds of estimations (especially at the aggregate level), which hamper obtaining proper regression results. Moreover, using the estimated parameters for simulations often results in improbable (high or low) values of the business ownership rate in the future.

The approach taken in this study is using the short-run equation for the business ownership rate and combining this with the turbulence equation to obtain gross entry and exit implicitly. Our approach implies that, through the error correction mechanism, entry and exit are geared in such a way that the business ownership rate will remain within certain bounds with respect to the underlying equilibrium.

The most striking result from the exercise explaining gross entry and exit is the suggestion that high unemployment mainly affects exits negatively (instead of gross entry positively). The negative effect of unemployment on exits may be invoked by a lack of good alternatives for business owners who are inclined to stop their businesses. Profitability, however, induces gross entry but does affect future exits.

Interpretation of the findings

Past development of business ownership

Using the results of the regressions we can deduce the contribution that each determinant had on the development of the business ownership rate.

1 From inquiries among entrepreneurs we know that the age category 35-54 years has the highest prevalence of entrepreneurship.

The long-run equilibrium

The structural development of the business ownership rate in the Netherlands shows a U-shaped trend. The equilibrium rate fell in the period 1960-1988. This is reflected in the long-run equation by the diminishing income differences in that period, compensating for the rise of the services sector. In the nineties, the services sector continued its growth, while income differences stopped declining. This explains the rise of the equilibrium business ownership rate in the period 1988-1996.

The annual changes

The actual development of the business ownership rate reflects both the underlying equilibrium and the short-term dynamics. The short-run equation serves in deducing the contributions from the determinants to the annual change in business ownership. The decrease in the business ownership rate in the late 1960s was – according to the model – mainly due to the low unemployment rates and diminishing income differences. The diminishing income differences were continued in the 1970s. Besides, a decreasing profit share reflected this period – that was not favourable for entrepreneurship. Unemployment started to rise, which had a negative effect on exits.

The post-war baby-boom generation reached the middle-aged category around 1982. An effect of the baby-boom generation does seem to be present, witness the actual development from 1982 to 1985. In 1985, the first increase in business ownership is observed. A temporary set-back, after the largest bulk of the ‘baby-boom business owners’ had started their businesses, may explain the decrease in the two following years. At the same time, the growth of the services sector relative to manufacturing declined.

At the end of the eighties, the negative development of the business ownership rate was reversed. The increasing business ownership rate is mainly explained by a combination of increasing profit shares, while the importance of the services sector relative to manufacturing was growing faster than before. It was reinforced by the income differences that tended to increase, while it was somewhat tempered by the decreasing unemployment[1]. Observed

1 Though the falling unemployment rate reduces business ownership according to the model, there is more behind this, as the falling unemployment rate may very well be caused by the employment created from the increased business ownership rate.

net entry rates are larger than the estimated ones. This may be the result of the efforts of the Dutch government to reduce barriers for starting (nascent) entrepreneurs, which have not been incorporated in our model.

Future development of business ownership

Using assumptions for the determinants of business ownership, we designed two scenarios for future development of the business ownership rate. Together with predictions of the labour force, this may be used to predict an expected number of business owners. In the reference scenario the business ownership rate is expected to continue its growth, be it at a smaller pace. The alternative scenario builds upon assumptions less favourable for business ownership and shows a more or less stable business ownership rate for 2000-2010. In both scenarios the exit rates rise towards the level of the entry rates until 2004 and then drop again.

Future research

In our scenario analysis it can be observed that the simulated actual business ownership rate trails behind the simulated equilibrium rate. This suggests that some additional determinants of (future) business ownership may be missing from the model. The effort of the Dutch government to reduce the barriers to entry may be one of those determinants. Further, there are recent indications that business ownership now attracts an increasing amount of younger people (see van Gelderen, 1999, and van der Kuip, 1999). The high immigration rate in the Netherlands can also be reinforcing for business ownership. A high number of migrants (high density), for instance in the urban regions, can stimulate migrants to create their own social structure, which requires entrepreneurship (van den Tillaart and Poutsma, 1998). Future research will have to focus on incorporating such missing variables.

Another improvement may be to disaggregate the model in sectors, using a top-down approach. Incorporating specific characteristics of specific sectors in the present model will make the total picture of business ownership development both more precise and more complete.

1 Introduction

Research goal

There is a substantial interest, in science as well as in policy circles, to understand the resurgence of business ownership or, equivalently, entrepreneurship[1], which has occurred in the Netherlands in recent years. What are the major causes? Will entry rates of new start-ups remain high? If so, what does that imply for future exit rates? Will the number of businesses keep rising? In spite of increasing interest in these questions the answers are still unknown.

The analysis is complex because the number of businesses must be viewed from the perspective of both the labour market (*supply side of business owners*) and the product market (*demand side of entrepreneurship*). Demand and supply of entrepreneurship, as well as the (possibility of) equilibrium, depend on cultural, technological, economic and regulatory factors. Many determinants will therefore have to be considered. Furthermore, dynamics are introduced by the interactions between entry, exit and the number of businesses. At the aggregate level econometric modelling seems to be a suitable approach to the problem at hand (see Wennekers, 1999). It will enable us to specify measurable relationships and to study the dynamics involved. Moreover, modelling will help us to better understand past performance and to foresee possible future developments. Within EIM's economic modelling programme SCALES it has thus been decided to start constructing an operational model of business ownership for the Netherlands.

Surplus value

We pay tribute to Blau (1987) who analysed the revival of business ownership in the USA with a general equilibrium model of business ownership and wage employment. Another study providing inspiration has been Parker (1996), who used a cointegration framework to analyse the changing balance between business ownership and wage employment in the UK. A pioneering study carried out by Carree et al. (1998) has broadened our outlook on underlying determinants of the changing proportions of business ownership in many OECD countries.

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1 We shall use the terms business ownership and entrepreneurship interchangeably; both will be understood to include non-incorporated businesses as well as the owner/managers of incorporated businesses.

An earlier study by Bosma et al. (1999a), providing a first attempt to model the resurgence of business ownership in the Netherlands, has served as a concrete point of departure for our project. Our current model, however, aims to add the following new elements:

- the endogenisation of a long-term (macro-economic) equilibrium rate of business ownership for the Netherlands;
- more elaborate model equations explaining gross entry and exit.

Structure of the report

In chapter 2 some relevant literature on the determinants of business ownership will be discussed. Next, in chapter 3, attention is focused on empirically modelling net growth of business ownership in the Netherlands in the long and the short run, by using the cointegration approach. Chapter 4 additionally presents an attempt to extend our model with separate equations for gross entry and exit. In chapter 5 we first use our model for analysing the changing business ownership rate in the Netherlands during the 1960-1996 period. Next, we present two scenarios of possible future developments of business ownership in the Netherlands. Chapter 6 considers some possibilities for future research.

2 Theory

2.1 Introduction

Business ownership can be viewed from both a static and a dynamic perspective. The static approach focuses on explaining the equilibrium number of business owners or, equivalently, the percentage of business owners in the labour force (the business ownership rate). The dynamic approach considers actual changes in the business ownership rate (net entry), as well as gross entry, exit and the sum of entry and exit (turbulence). In our brief review of the literature we will primarily focus on the business ownership rate and on net entry[1].

As stated in the introduction, the number of business owners results from forces at the supply side (representing the labour market perspective of occupational choice) and the demand side (representing the carrying capacity[2] of the market). Additionally, institutions and specific entrepreneurship policies play a role in determining the prevalence of business ownership, either by influencing the supply and demand factors or by influencing the relevant mechanisms (see Verheul et al., 2000).

The supply side of entrepreneurship encompasses demographic developments (such as age distribution, immigration, labour force participation of women), so-called push factors (such as unemployment) and pull factors such as relative returns versus opportunity costs (risk-reward profile of entrepreneurship). The demand side of entrepreneurship is strongly influenced by technological developments. It can be viewed from a consumer's and a firm's perspective. Within the first perspective, diversity of consumer demand is important. The larger this diversity, the more room is created for (specialised) businesses. Within the second perspective, the focus is on the industrial structure (sector structure, outsourcing, networking, economies of scale).

Similar to product markets, there may be both price and non-price mechanisms that link the demand and the supply of business ownership, resulting in an equilibrium level[3]. We consider the relative financial return of business ownership (profit rate versus wage rate) to be a good proxy of the clearing price of the market for busi-

1 Some relevant literature on gross entry and exit will be discussed in chapter 4.
2 The term 'carrying capacity' is taken from Carree and Thurik (1999).
3 For an extensive treatment of the equilibrium rate of business ownership see de Wit (1993).

ness owners. Moreover, one may assume that economic agents weigh these financial returns against the risks involved in either business ownership or wage employment. Following this line of thought one may consider the risk-reward profile of business ownership versus that of wage employment as the clearing mechanism[1]. Next, non-pecuniary rewards such as status may also be involved in allocating talent to alternative occupations[2]. Finally, institutional rigidities such as entry regulation may give rise to rationing.

The relevant determinants of business ownership at the demand and the supply side are discussed in sections 2.2 and 2.3, respectively, while attention is also paid to some relevant institutional factors. In section 2.4 we briefly discuss an econometric technique (cointegration analysis) for modelling the rate of business ownership within an equilibrium framework.

2.2 Demand side of business ownership

The demand side of business ownership can be viewed from two perspectives: demand from the firms' perspective and demand from the consumers' perspective.

From the firms' perspective technological change is the prime driving force behind entrepreneurship. The sixties and early seventies were dominated by rather stable technological trajectories, in which increasing scale could reap economies. This development contributed to an increase in average firm size in many Western economies. The last quarter of the 20th century, however, brought the advent of new technological paradigms, such as most notably the information and communication technology (ICT) revolution, creating a wave of process and product innovations. ICT tends to decrease scale economies, thus creating possibilities for small firms. It also decreases transaction costs, thus stimulating the trend towards outsourcing and favouring networks of independent producers above large corporations[3]. Additionally, the wave of new products means that an increasing share of products is positioned at an early stage of the product life cycle. As young industries usually have room for a relatively large number of enterprises (see Carree and Thurik, 2000, and Klepper and Simons, 1999), this again stimulates business ownership.

1 Using risks to calculate lifetime returns the risk-reward profile may still be viewed as a price.
2 See Acemoglu (1995).
3 See Bernardt (2000).

In most industrialised countries the increasing supply of new products has been reinforced from the consumers' perspective. Jackson (1984), in an article on 'the Engel curve for variety', provides quantitative evidence of the rapid increase in the variety of goods and services purchased with income. In particular, he demonstrates that higher income groups not only have higher consumption expenses per household, but also purchase larger numbers of different commodities per household. We assume that in the past decades the differentiation of consumer demand was driven by both a growing level of per capita income and, at least since the eighties, by an increasing income disparity. And again, through this increasing diversity in consumer demand more room was created for entrepreneurship. Empirical support for the influence of income differences on business ownership is provided by Ilmakunnas *et al.* (1999).

The sector structure (as for instance indicated by the employment share of service industries, or the ratio between services and manufacturing industry) may also influence the rate of business ownership. Increasing prosperity brings in its wake an increasing share of the services and particularly of personal and business services (see Inman, 1985, and François and Reinert, 1995). On average (and barring railways, airlines and communication services) the service industries are characterised by a relatively small enterprise size, reflecting a higher demand for business ownership. Besides, many (new) firms in the service sector spring from outsourcing by other and often large firms in manufacturing.

2.3 Supply side of business ownership

The supply side of business ownership is rooted in micro-economic decision making with respect to occupational choice. In our analysis we must somehow aggregate from the individual to the macro-economic level.

As propensities towards business ownership differ between demographic groups, several characteristics of the population such as (changes in) the age distribution and the female labour participation rate may be relevant here. People in the middle-age cohorts have the highest prevalence of incumbent business owners. However, prevalence rates of nascent entrepreneurship are highest in the age group between 25 and 34. Future developments may of course change the propensities to start a business for each age category.

Next, personal characteristics (skills and attitudes) may influence the decision to prefer business ownership to wage employment. A prominent example of such a characteristic is the degree of risk aversion (see Kihlstrom and Laffont, 1979, and van Praag, 1996, chapter 5). Also the availability of role models, perceptions of desirability and previous experiences (emigration and other displacements, job dissatisfaction) may play a role in this respect. The surveys by Brockhaus (1982) and by Shapero and Sokol (1982) provide an overview of relevant variables. However, it is difficult to gather aggregate data on cultural values and personal qualities necessary for our analysis at the macro level. Besides, many of these variables, such as the cultural characteristics assembled by Hofstede (1980), are probably rather stable over longer periods of time (see Wildeman et al., 1999, p. 25).

The supply side may be viewed from an alternative angle by distinguishing between push and pull factors.

The main economic push factor besides job dissatisfaction is (threat of) unemployment. A high level of unemployment is assumed to result in more start-ups, but might also negatively influence the number of business exits (few job alternatives). However, when structural unemployment is very high this may also cause a feeling of malaise and discourage business ownership (see Hamilton, 1989, and Meager, 1992). A positive effect of unemployment on the number of business owners (net entry) has been demonstrated in several empirical studies (see Storey, 1991, and Carree et al., 1998), but evidence about the influence of unemployment on gross entry is scant. Finally, the so-called replacement ratio between unemployment benefits and (average or minimum) wages also influences the propensity of unemployed persons to become business owners.

A major economic pull factor is the expected entrepreneurial income versus expected wage income. Obviously, the better the prospects of entrepreneurial income as compared to the wage income of an employee, the lower the opportunity costs of business ownership and the more people will be attracted to becoming business owners. However, occupational choices are also influenced by the risks of business ownership (failure) versus those of wage employment (dismissal). In this respect a more flexible labour market may lower the opportunity costs of business ownership. Finally, a high interest rate may also imply high opportunity costs of business ownership because of foregone alternative investment opportunities. Besides, personal financial resources often do not suffice for a business start-up, which forces potential entrepreneurs to make use of other sources of capital, like debt capital. A high interest rate will thus discourage these potential entrepreneurs from starting up a business, because of the high costs of debt capital. For empirical support of these contentions see Evans and Jovanovic (1989) and Parker (1996).

Acemoglu (1995) argues that reward structures can be both pecuniary and non-pecuniary (respect and status). Murphy et al. (1991) extend the analysis by considering the allocation of entrepreneurial talent over wage employment, entrepreneurship and rent seeking, which is driven by relative rewards.

Van Praag (1996) applies several of the above-mentioned factors by distinguishing between willingness (depending on both individual preferences and alternative options) and opportunity (including both entrepreneurial abilities and the availability of financial resources). Growth in average wealth (including equity, inheritances, development of house prices, etc.) may contribute to the supply of entrepreneurship as more people have financial opportunities to start a business. The wealth distribution may also be of relevance.

Finally, regulations and taxes may function as a barrier to entrepreneurship. Research in Sweden, for example, indicates that a high share of large enterprises may result from poor regulation with respect to starting and existing small companies. See Davis and Henrekson (1999) and Henrekson and Johansson (1999). Another study for the Netherlands indicates that business licensing may hinder entry of new enterprises (see Bosma et al., 1999b).

2.4 Modelling business ownership within an equilibrium framework

An equilibrium framework

As stated in section 2.1 it is assumed that the interplay of forces on the supply and the demand side results in an equilibrium level of business ownership. The risk-reward structure probably plays a pivotal role in the equilibrium seeking mechanism. Institutions such as regulation of entry may also influence the outcome and may result in lower equilibrium level due to non-price mechanisms (rationing). On the other hand financial support of entrepreneurship or strong developments at the supply side may result in a higher equilibrium.

In our present study of business ownership in the Netherlands at the macro level it is our aim to make a first attempt at specifying and estimating a structural model of business ownership within an equilibrium framework. Conceptually, we believe that the business ownership rate can be described by a long-run (equilibrium) relationship, combined with a short-run relationship that is partly explained by the deviation of the observed rate from the estimated long-run rate. The long-run (equilibrium) rate is not necessarily an optimum, and thus also differs conceptually from the equilibrium rate as derived in Carree et al. (1998)[1]. In fact, because of distorting forces such as regulation, the long-run rate may not even be free market equilibrium in the sense that demand equates supply at the equilibrium 'price'.

Cointegration analysis

Cointegration analysis[2] has the favourable property that the long run and short run are combined. Error correction is modelled being part of a short-run equation, using the residuals from the estimated long-run relation. The long-run equilibrium rate reflects the direction to which value the rate tends to converge. The determinants of the demand of entrepreneurship, such as the sector structure and the level or distribution of wealth, seem to be most suitable for this long-term approach. Most of the determinants of the supply of entrepreneurship are assumed to primarily influence the short-run development of business ownership. We have used variables like unemployment, the profit share and the share of middle-aged people to explain the change in business ownership (i.e. net entry). In the next chapter we apply our method to the Netherlands at the macro level.

1 Carree et al. (1999) have assumed an equilibrium relationship between the business ownership rate (related to labour force) and the stage of economic development. In that study, an equilibrium rate was estimated in a cross-country regression for 23 OECD countries. It was also found that a deviation from the (international) equilibrium implies a penalty on economic growth. In that sense their assumed equilibrium is also an optimum solution. However, the model specified by Carree et al. assumes a strict relationship with the level of per capita income, making equilibrium almost exogenous or at best a reduced form solution of an underlying structural model.

2 Parker (1996), whom we already cited in chapter 1, was the first to use cointegration for modelling the business ownership rate, using data for the United Kingdom. Whereas Parker models a monotonic transformation of the business ownership rate, for practical purposes we choose to model the rate itself. A brief review of Parker's modelling framework is provided in appendix III.

3 Empirical analysis of the business ownership rate of the Netherlands

3.1 Introduction

In this chapter we arrive at modelling the theoretical notions of the previous chapter. There, it was suggested to use the cointegration technique. The step-by-step approach of this technique is set out extensively below and is illustrated using the time series data at our disposal. The characteristics of the time series data are dealt with in section 3.2. In the subsequent section we explore the long-run equilibrium relationship of the business ownership rate, whereas in section 3.4 the short run is investigated. This chapter closes with a discussion in section 3.5.

Throughout this chapter, the estimation technique is dealt with while omitting technical details as much as possible. For a technical description of the cointegration technique we refer to appendix II.

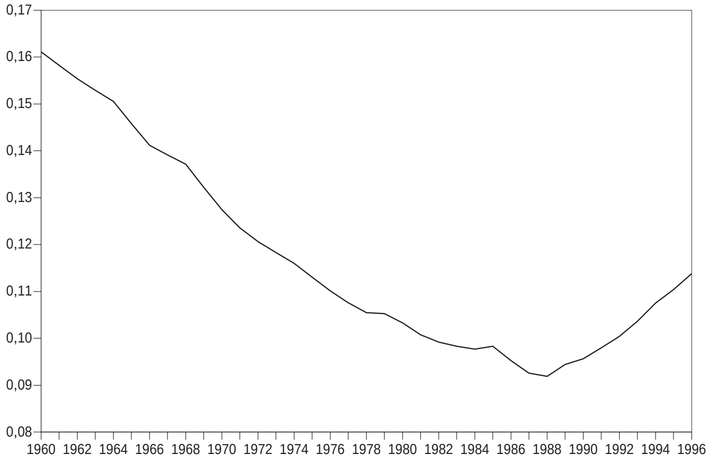
3.2 Time series data

The literature investigation of chapter 2 proposed several possible determinants for modelling business ownership. Our intention is to create a model that gives a good explanation of the business ownership development of the past decades in the Netherlands and to make predictions for the future based on this model. This implies that the determinants of business ownership, as explored in the previous chapter, should be quantifiable for the whole time period used in the estimation. This makes some intuitively appealing determinants unsuitable for the model that is to be constructed. The most important determinants could be included though.

Business ownership rate in the Netherlands

The business ownership rate is the dependent variable in our model. As can be seen in Figure 1, the development of this rate in the Netherlands takes a U-shape, with the lowest point in 1988. Before 1988, the Dutch economy was characterised by increasing large-scale production, and it was believed that increasing returns to scale were favourable for economic growth. There was little attention for small firms, as these were not believed to increase overall wealth. A large share of small businesses accompanied with great business dynamics may function as an accelerator for the economy though. This notion is dominating in the last decade. The increasing popularity of entrepreneurship is reflected in the past ten years in the Netherlands by an increasing business ownership rate, following the example of the USA and other western countries such as Great Britain and Canada. The notion of small businesses to function as the engine of the economy has resulted in a great attention for small businesses, and the government explicitly stimulates entrepreneurship, trying to minimise the barriers for nascent entrepreneurs to start a business[1].

Figure 1 Business ownership rate in the labour force for the Netherlands, 1960-1996



Source: EIM; CBS.

Time series: unit roots and the orders of integration

Considering the development of the business ownership rate in Figure 1, it is obvious that the values are auto-correlated; the observation in a particular year is dependent on the observation of the preceding year. This is a general characteristic of time series data. In that case, the time series are said to have a *unit root*. A frequently used test for unit roots in a time series *TS* is to run a regression of the lagged variable (TS_{t-1}) on the annual change (first differences):

(3.1). $$\Delta TS_t = \mu + \gamma t + (\rho - 1) TS_{t-1} + u_{it} \qquad u_{it} \sim IID(0, \sigma_i^{\,2}).$$

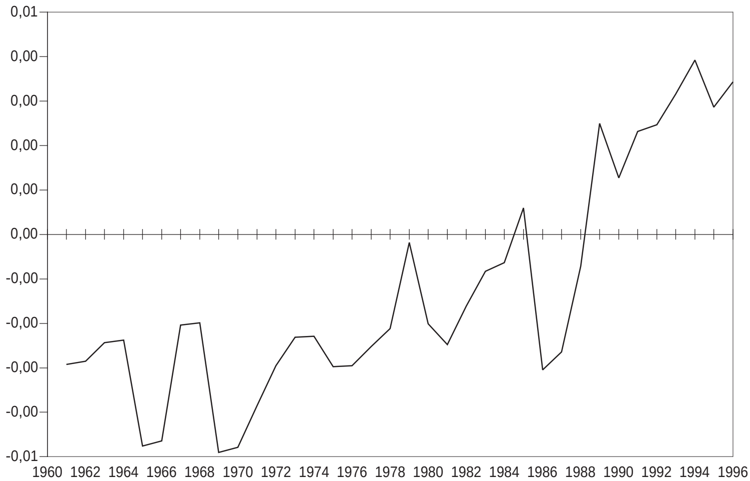
1 See the government white paper *De ondernemende samenleving* (in Dutch), Netherlands Ministry of Economic Affairs, 1999.

TS is said to have a unit root if the time series is non-stationary; that is, the annual change cannot be proved (at a certain significance level) to be negatively related to the lagged variable. If *TS* has a unit root, it is called integrated of order one, denoted by *I(1)*. As expected, the business ownership rate turns out to have a unit root. The annual change in the business ownership rate is plotted in Figure 2. It can be seen that the change in a particular year is predominantly positively related to the change in the previous year. This suggests that even the first differences of the business ownership rate have a unit root. In that case, the business ownership rate is integrated of order two, denoted by *I(2)*. We now estimate the following relationship:

$$(3.2).\quad \Delta\left(\Delta TS_t\right) = \mu + (\rho - 1)\Delta TS_{t-1} + u_{it} \qquad u_{it} \sim IID(0, \sigma_i^{\,2})\,.$$

There are two small differences with respect to equation (3.1). First, the trend parameter γ is left out, as these time aspects are corrected for when the series is differenced twice. Second, we lose one observation each time a series is differenced. The regression results in accepting a unit root for Δ*TS*, which makes *TS I(2)*.

Figure 2 First differences of the business ownership rate in the Netherlands, 1960-1996



From Figure 3, we see that the second differences generally show little positive dependence with respect to preceding observations. The hypothesis that these second differences have a unit root as well – applying a regression analogous to equation (3.2) – is indeed rejected.

Figure 3 Second differences in the business ownership rate in the Netherlands, 1960-1996

The importance of unit roots in modelling time series

Above we explored the characteristics of the business ownership rate. It is important to know whether a time series (and possibly the first and second differences) has a unit root. A unit root means that the series may contain stochastic trends and thus be non-stationary. Applying plain regressions on non-stationary time series may result in estimates whose significance follows directly from the non-stationarity of the data and not from the suggested interdependence (it is in fact spurious correlation).

The economic interpretation of cointegration is that if two or more series are linked to form an equilibrium relationship spanning the long run, then even though the series themselves may contain stochastic trends (i.e. be non-stationary) they will nevertheless move closely together over time and the difference between them will be stable (i.e., stationary). Thus the concept of cointegration mimics the existence of a long-run equilibrium to which an economic system converges over time. The deviation of the actual data from the long-run equilibrium can be interpreted as the equilibrium error.

Following directly from the identification of cointegration with equilibrium, it is possible to make sense of regressions involving non-stationary variables. If these are cointegrated then regression analysis imparts meaningful information about long-run relationships, whereas if cointegration is not established we return to the subject of spurious correlation. Cointegration is very closely linked to the use of short-run error correction models, thus providing a useful and meaningful link between the long- en short-run approach to econometric modelling.

From the features set out above[1] it becomes clear that a well-fit cointegration analysis must fulfil two conditions.

1. All time series variables must have the same order of integration.
2. The residuals of the estimated long-run relationship must have a lower order of integration.

The first condition implies that the order of integration has to be investigated for all variables before the long-run equation can be stated. After this the second condition can be tested. We already explained the process of testing for unit roots using the business ownership rate. The same has been done for the other variables. The results are set out in Table 1[2].

The income differences, the share of mid-aged people and the sector structure have the same order of integration as the business ownership rate. The unemployment rate and the profit share are not to be included in the long-run equation, considering the lower order of integration. Both variables do have the same order of integration as the first differences of the business ownership rate (being the net entry rate). The net entry rates are used for estimating the short-run equation. Therefore, the unemployment rate and the profit share will show up as determinants of the short run. This is supported by empirical studies in which (net) entry is partly explained by the business ownership rate and the profit share as a measure of profitability.

Table 1 Orders of integration: (non-)stationary characteristics of the data

Variable	Definition*	Order of integration
BO_RATE	Number of business owners related to labour force	2
Y_DIF	Income differences	2
MIDAGE	Share of middle aged people in total population	2
U_RATE	Unemployment rate	1
PROF_SHARE	Profit share	1
SECTOR	Sector structure measure	2

* A more comprehensive definition is given in appendix I.

1 The features mentioned in this section are limited in the sense that no justification is given, this can be found in appendix II.
2 For more technical matters of the method applied we refer to appendix II.

3.3 The long run

In the previous section we selected the variables that were fit for the long-run cointegration analysis. All selected variables were shown to have the same order of integration, namely order 2. We denote this as all variables being *I(2)*. For the long-run equation, it is now the challenge to find the smallest, best subset of variables that are cointegrated, while keeping the underlying interpretations clear. In other words, the final equation must fulfil the following:

- The economic interpretation of the suggested relation is warranted.
- The series are cointegrated.
- Once any of the variables is left out, the series will no longer be cointegrated.

Long-run equation

The long-run business ownership rate in our model is explained by income differences and the sector structure characteristic. As set out in the previous chapter, income differences are assumed to have a positive influence on the supply side as well as the demand side of entrepreneurship. The sector structure proxy is defined as the number of employees in services divided by the number of employees in manufacturing and thus measures the trend of increasing demand for services. Including *MIDAGE* induces only minor adjustments to the estimation result and is therefore abandoned in this equation. The estimation of the business ownership rate, explained by *Y_DIF* and *MIDAGE*, results in a similar cointegration relationship. *MIDAGE* and *SECTOR* both show an upward sloping trend. The sector structure variable is preferred on theoretical grounds. Besides, it outperforms the share of middle-aged people when both variables are included in the equation.

A favourable feature of the variables used is that both have a kind of natural lower and upper bound, for the same can be assumed for the rate of business ownership. The estimated long-run equilibrium rate is not designed to explain the observed development of the business ownership rate fully. It indicates the direction in which the rate tends to converge. It is hypothesised that income differences affect business ownership after five years. The lag of the sector structure measure is set at one year.

Summarising, the two variables that appear in the long-run equation reflect a combination of sector structure, wealth and income distribution. In chapter 2 these were considered as important long-run determinants for business ownership. The dependent and the independent variables were already seen to have the same order of integration in Table 1. Thus, these variables are thought to suffice for adequately forecasting the long-run rate of business ownership. The empirical investigation gives no evidence against this opinion, witness the outcome of the least squares regression of the long-term equation (t-values are between parentheses):

(1) $BO\_RATE = 0.086\ Y\_DIF(-5) + 0.0144\ SECTOR(-1) + 0.107$
(19.2) (6.51) (39.2)

$R^2_{adj} = 0.97$

$DW = 0.61.$

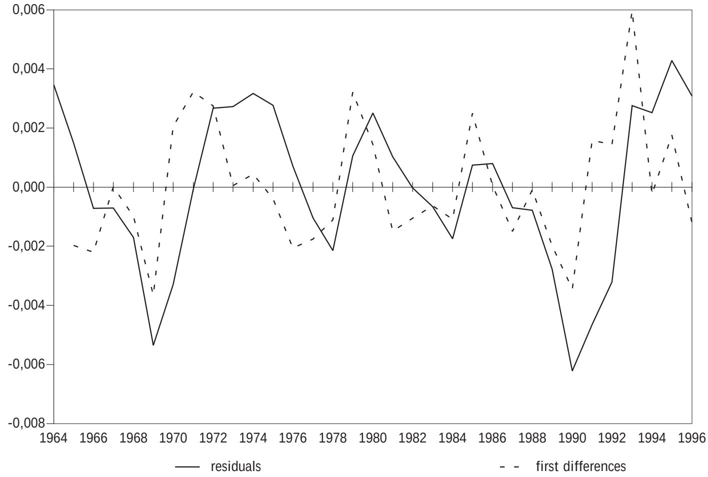
Obviously, the goodness of fit of this model is satisfying – though the high R-squared value of 0.97 is certainly not unusual in these kinds of long-run time series estimations. The T-values printed should not be compared with the usual critical values for T-test, as the Durbin Watson (DW) statistic is very low.

The low DW statistic is not to be worried about, because – provided that the series used are cointegrated – the so-called super consistency rule of Engle and Granger can be applied. Simply put, this super consistency rule implies that serial correlation in the residuals does not mean that the model is wrongly specified, as the autocorrelation is explicitly accounted for using the cointegration technique. This naturally leaves us to test for cointegration.

Cointegration test

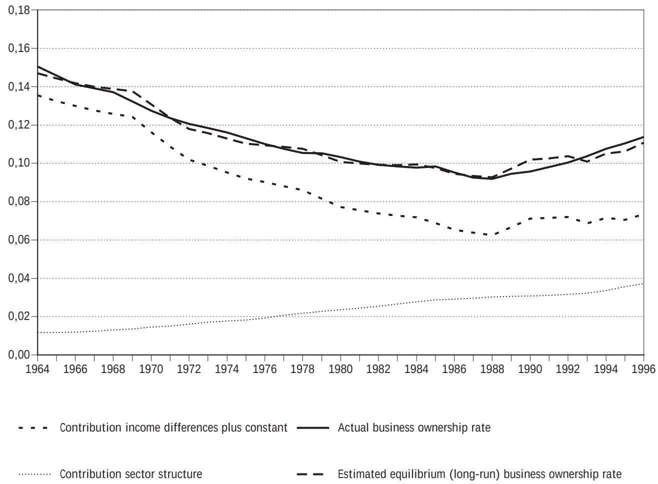
The cointegration test implies testing for the residuals of the long-run equation to have a lower order of integration than the order of integration of the variables contained in the long-run equation. Critical values are, however, different from the Dickey-Fuller values used earlier in establishing the orders of integration. The ones to be used in this case can be found in appendix II. In Figure 4 it can be seen graphically that the residuals follow a cyclical pattern, while behaviour of the first differences of the residuals seems to be more random. The cointegration test on these residuals does not reject stationarity. Note that stationarity of the first differences suffices for the time series to be cointegrated.

Figure 4 Residuals from the long-run equation and their first differences



Thus, the outcome of the test is that the series are indeed cointegrated. Figure 5 demonstrates the contributions of income differences and the sector structure measure for the long-term regression. The observed falling business ownership rate until 1988 is mainly explained by the reduced income differences. The rise after 1988 is explained by the increasing importance of services relative to manufacturing, while income differences now tend to rise as well.

Figure 5 Long-run relationship of the business ownership rate in the Netherlands and the estimated contributions from income differences (*Y_DIF)* and from sector structure (*SECTOR*), 1961-1996*



* In the chart, the constant is added to *Y_DIF.*

Having established the 'stable' long-run relationship, we can now use the residuals of equation (1) and investigate the short-run relationship.

3.4 The short run

For the short-run equation, we consider the first differences of the business ownership rate. Apart from the determinants that already appeared in the long-run equation (income differences and the sector structure), unemployment rates and the profit share in production enter the equation. It is hypothesised that an increase in unemployment will lead to an increase in business ownership in the short run. An increase in the profit share is more attractive to the business owner, so a positive relation is expected between the profit share and the change in the business ownership rate. The fact that both variables are not present in the long run does not necessarily mean that the long-term effect is not present, as income differences may be affected by unemployment and profit shares. Both variables are allowed a period of five years to affect the business ownership rate.

The third additional determinant for explaining the net entry rate is the share of middle-aged people. In the observed time period most entrepreneurs (in a relative perspective) are in the middle-aged category[1] and, therefore, the share of middle-aged people can be considered as an important determinant[2]. The share is lagged with one year.

We use the residuals from the long-run equation for estimating the error correction effect. A deviation from the actual business ownership rate with respect to estimated long-term (equilibrium) rate is expected to be followed by an adaptation towards the long-run rate. The associated coefficient should be negative: an observed rate below (above) long-run equilibrium implies negative (positive) residuals for the long-run equation and the short-run rate should have a positive (negative) effect in order to adapt to the long-run rate.

1 This is a general result that follows from inquiries among entrepreneurs. Our middle-aged category is set at 35-54 years.

2 Recently (partly as a result of policy conduct), young people are increasingly attracted towards entrepreneurship - a trend that may be continued for future years. This observation may be used in a scenario for the future.

Short-run equation

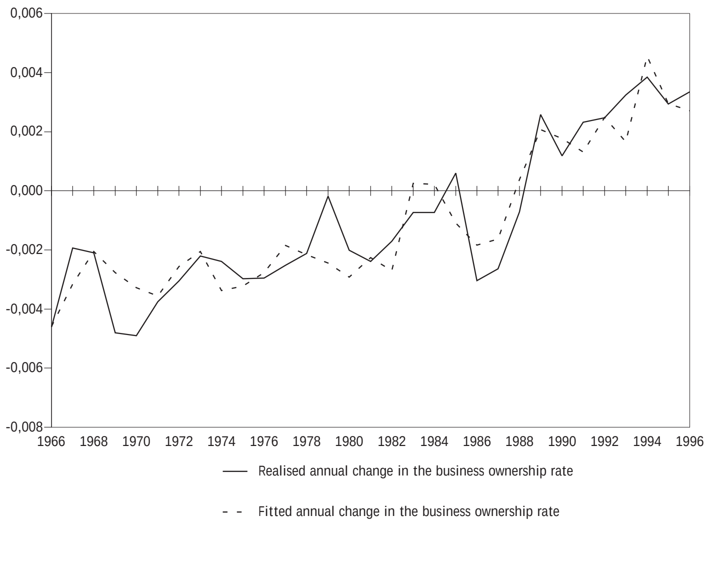
The estimated short-run relationship is the following (t-values are between parentheses):

$$(2)\quad \Delta\, BO\_RATE = 0.0233\, \Delta Y\_DIF\,(-5) + 0.407\, \Delta MIDAGE\,(-1) + 0.0175\, PROF\_SHR\,(-5)$$
$$(2.23) \qquad (2.51) \qquad (2.86)$$
$$+ 0.0321\, U\_RATE(-5) + 0.0276\, \Delta SECTOR\,(-1) - 0.305\, ERROR\_CORR\,(-2) - 0.0066$$
$$(3.09) \qquad (3.52) \qquad (-3.20) \qquad (-4.94)$$
$$R^2_{adj} = 0.81$$
$$DW = 1.86.$$

All coefficients of the independent variables have the hypothesised signs and are estimated significantly different from zero. The error correction is lagged two years. This means that the error correction mechanism takes some time before it can be observed.[1]

In Figure 6 it can be seen that the estimated series fit the observed series pretty well, which was already indicated by the reasonable value (0.81) of the adjusted R^2.

Figure 6 Short-run relationship of the business ownership rate in the Netherlands, 1961-1996; estimated values and realised values



1 Applying a lag of one year for the error correction resulted in a significant estimate as well. However, the two-year lag effect appeared to be stronger and to outperform the one-year lag.

Error correction

The error correction enters the short-run equation using the residuals of the long-run equation. If the observed business ownership rate was below the estimated long-run business ownership rate (which is reflected by negative residuals), the error correction approach expects the short-run business ownership rate to move towards the long-run rate. Thus, the expected sign of the error correction coefficient is negative. The thing to be looked at is not only the (negative) significance of the error correction component. The value says something about the pace in which the observed business ownership rate oscillates around the long-run rate. A value of 0.305 means that – on average – a deviation of the actual business ownership rate from the equilibrium rate is corrected for by 30.5% within two years. This error-correction effect is additional to the effects that are estimated from the other determinants. It is conceivable that adaptation to the long-term business ownership rate will take place through variables like unemployment and the profit share as well.

3.5 Discussion

In this chapter we constructed a macro-economic model explaining the observed business ownership rates in the Netherlands in the period 1965-1996. Our results point at a relationship in which the course of the business ownership rate is directed towards a long-run rate. This long-run rate primarily depends on the demand for entrepreneurship, reflected by income differences and sector structure. However, income differences also stimulate the supply of entrepreneurship.

Additional determinants are modelled in an equation explaining the change in the business ownership rate (the short-run rate). These determinants include profitability, unemployment and demographic variables. All variables were shown to have positive effects on the short-run business ownership rate – as hypothesised. The error correction (reflecting the adaptation of the short-run rate towards the long run) was also estimated significantly different from zero. Moreover, using the estimation results, the observed fluctuations of the business ownership rate in the Netherlands could be credibly explained.

In this model, we remark that the role of gross entry and exit is still only implicit. The short-run equation explains the change in business ownership, which is defined by the annual total number of entries minus the annual total number of exits. If it is possible to ‘untangle’ the observed net entry and explain the gross entry and exit that lie behind this net entry, we learn a lot more about the underlying business dynamics. The possibilities to separate entry and exit will be explored in chapter 4.

4 Inclusion of gross entry and exit in the model

4.1 Introduction

In the previous chapter we explored the *development* of the rate of business ownership mainly by explaining the net entry rate in equation (2). Apart from its development, policy makers are also interested in the *dynamics* of the rate of business ownership. A particular net entry rate does not reveal the actual number of gross entries and exits of businesses, or its sum (turbulence). However, for economic policy it is also important to know whether gross entry and exit are relatively high or not. A high level of turbulence is associated with highly competing markets[1]. Increasing competition is one of the main purposes of western countries' government policies, as competition is believed to induce economic growth[2]. Therefore, we add an equation explaining the turbulence of businesses – defined as the sum of entry and exit – to the model.

4.2 Theory

Fluctuations of gross entry and exit are increasingly studied at the sector level[3]. In the nineties, many empirical investigations have been practised as data availability rose[4]. Most estimations of the determinants of entry and exit are based on the specification introduced by Orr (1974), extended by Shapiro (1983) and Baldwin and Gorecki (1983). Common practice is to relate observed entry and exit to the existing number of firms in the sector and to regress these on the hypothesised determinants. Determinants of entry and exit are often separated in barriers to entry and incentives to entry. Barriers to entry (like capital intensity and R&D intensity) are also believed to be barriers to exit due to sunk costs. Incentives for entry (like profitability and unemployment), however, are generally hypothesised to affect exits in the opposite direction.

1 Nieuwenhuijsen et al. (1999) apply a principal component analysis and find that turbulence is the indicator to be used for business dynamics.

2 For example, Birch et al. (1997) suggest that turbulence is an important feature of economic growth using regional data from the United States. Also, Bosma and Nieuwenhuijsen (2000) find a positive influence of turbulence on total factor productivity using Dutch regional data.

3 Modelling gross entry and exit at the micro level proceeds from the individual's decision to start up a firm or to exit the industry. Examples of these models can be found in de Wit (1993) and van Praag (1996). In the present study, however, we focus on the macro level. At this level, studies are known that mainly benchmark the gross entry and exit characteristics among countries. See for example Verhoeven et al. (1999). Models at the sector level come closest to our aims of introducing gross entry and exit in the model developed in the previous chapter.

4 Without being complete we mention Baldwin (1993), Kleijweg and Lever (1994), Geroski (1995), Carree and Thurik (1996), Fotopoulos and Spence (1998) and Bosma et al. (1999b).

A common difficulty in estimating the coefficients for barriers and incentives is that entry and exit within industries are highly correlated. Moreover, gross entry may induce exit – through displacement or failure – and exit may induce gross entry through replacement. However, modelling these interactions directly often tends to over-estimations of the interrelation between gross entry and exit (and possibly under-estimation of the other determinants).

Estimating gross entry and exit equations simultaneously thus often leads to doubts whether the right relationships are estimated. This problem gets larger when the level of aggregation rises, as gross entry and exit show higher correlation at higher aggregate levels.

A last comment on modelling gross entry and exit is the following. Gross entry and gross exit are often expressed in percentages of the stock of businesses. If last decade's trends of these measures are continued for the future, this is seen to be not credible to sustain for the future. This is because the Netherlands has experienced gross entry rates that increased and stabilised after a while. The exit rates also increased, though at substantially lower pace (and level) than the gross entry rates. This resulted in the observed rapid rise of the number of businesses. If we assume the number of entries and exits to keep in line with the number of businesses (the denominator of the entry and exit rates measure) it is obvious that the resulting number of businesses will 'explode' through this repeated circle mechanism.

4.3 Framework

Having in mind the arguments that were made in the previous chapter, we look for a new method to include gross entry and exit in the model. We begin with recapturing the equations estimated so far:

(1) $BO\_RATE = 0.086\ Y\_DIF(-5) + 0.0144\ SECTOR(-1) + 0.107$
$\quad\quad\quad\quad\quad\quad\quad (19.2) \quad\quad\quad\quad (6.51) \quad\quad\quad\quad (39.2)$

(2) $\Delta\ BO\_RATE = 0.0233\ \Delta Y\_DIF(-5) + 0.407\ DMIDAGE(-1) + 0.0175\ PROF\_SHR(-5) +$
$\quad\quad\quad\quad\quad\quad\quad (2.23) \quad\quad\quad\quad (2.51) \quad\quad\quad\quad (2.86)$
$0.0321\ U\_RATE(-5) + 0.0276\ \Delta SECTOR(-1) - 0.305\ ERROR\_CORR(-2) - 0.0066$
$(3.09) \quad\quad\quad\quad (3.52) \quad\quad\quad\quad (-3.20) \quad\quad\quad\quad (-4.94).$

In equations (1) and (2), the business ownership rate (*BO_RATE*) is defined as the number of business owners relative to total labour force. It is more common for the net entry rate and the turbulence rate to be expressed relative to the stock of businesses (which we equate to the number of business owners in our analysis). We will refer to the net entry rate (*NET*) as calculated relative to the stock of enterprises. The turbulence rate (*TURB*) is defined analogously. The underlying relationship between the short-run rate (ΔBO_RATE) and the net entry rate can easily be derived:

$$\Delta BO\_RATE = \Delta\left(\frac{BO}{N}\right)_t = \frac{BO_t}{N_t} - \left(\frac{BO_{t-1}}{N_t}\frac{N_t}{N_{t-1}}\right) \Leftrightarrow \frac{N_t}{BO_{t-1}}\Delta\left(\frac{BO}{N}\right)_t = \frac{BO_t}{BO_{t-1}} - \frac{N_t}{N_{t-1}}$$

$$NET_t = \frac{\Delta BO_t}{BO_{t-1}} = \frac{BO_t}{BO_{t-1}} - 1 = \frac{N_t}{BO_{t-1}}\Delta BO\_RATE_t + \frac{N_t - N_{t-1}}{N_{t-1}}.$$

Thus, the net entry rate can be written as the change of the business ownership rate estimated earlier, multiplied with a ratio correcting for the different denominator. This means that a particular growth of the business ownership rate has larger effects on the net entry rate for smaller values of the business ownership rate. Additionally, the annual change in labour force is corrected for. The intuition behind this correction is that an increase in labour force – assuming a stable business ownership rate – implies an increase in the number of businesses. Net entry is therefore positive, whereas the business ownership rate remains constant.

When we apply the transformation as set out above to the right-hand side of equation (2), we see that the coefficients of the individual independent variables may vary over time due to the fact that *(N/BO)* is not constant over time. In the turbulence equation, we will assume constant coefficients however:

$$TURB_t = \tau XT_t + \varepsilon_t^{TURB} \qquad , \varepsilon^{TURB} \sim IID(0, \sigma_\varepsilon^2);$$

with in *XT* the variables affecting turbulence (some or all variables may be the same as in the net entry equation). We hypothesise that the error correction affects net entry in such a way that it is reflected by gross entry and exit with equal shares (note that the signs are opposite). The same goes for the labour force effect: an increase in labour force is assumed to affect the gross entry rate and the exit rate equally. We included profitability, unemployment and sector structure in our turbulence equation. We excluded the variables on income differences and middle-aged category because we find no reasons to believe that these variables act as determinants of turbulence[1].

The estimation results are the following:

$$\text{(3)} \quad TURB = 0.223\, PROF\_SHR(-5) \; -0.148\, U\_RATE(-5) \; + 0.037\, \Delta SECTOR(-1) \; + 0.0813$$

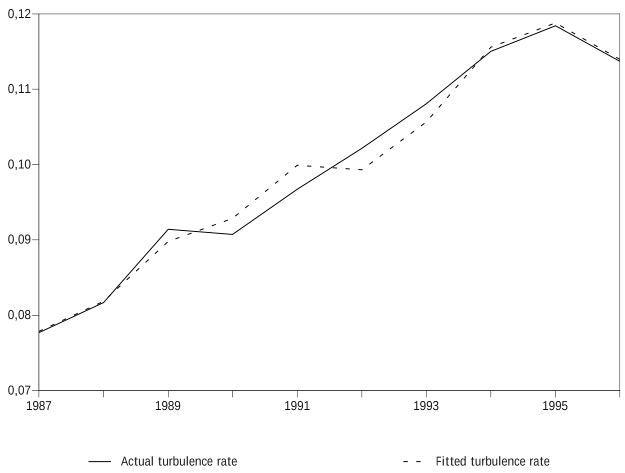
(6.55) (-1.92) (1.12) (8.16)

R^2_{adj} = 0.96

DW = 1.85.

Turbulence data are available from 1987 onwards only, while we require data back to 1960 for our analysis. The estimated values are compared to the actual values in Figure 7.

Figure 7 Actual and fitted values of the turbulence rate, 1987-1996



We can now calculate the implications for gross entry and exit easily:

$$\text{(4)} \quad ENTRY_t = (TURB_t + NET_t)/2$$

$$\text{(5)} \quad EXIT_t = (TURB_t - NET_t)/2 \cdot$$

As the coefficients of *NET* are time varying, so are the coefficients of *ENTRY* and *EXIT*. In Table 2 we printed the coefficients of the three equations we estimated, i.e. equations (1)-(3). Additionally, we calculated the coefficients for equations (4) and (5) for different business ownership rates spanning the range of the observed rates.

1 The exclusion of *Y_DIF* and *MIDAGE* in the turbulence equation was supported by empirical testing: inclusion results in insignificant effects (without affecting the other coefficients) and the likelihood ratio test outcome suggests that including these variables does not improve the model.

Most coefficients of entry are seen to have opposite signs with respect to those of exit. A comment on the variables regarding unemployment and profitability is in order. Unemployment does not seem to strongly influence the number of entries. This result was also found in Bosma and Zwinkels (1999) and in Verhoeven *et al.* (1999). On the other hand, Carree et al. (1998) found a positive relation between unemployment and business ownership. It is often suggested that this might be due to more *gross* entry, but our results suggest that a decline of exits is more important in explaining the resulting growth of business ownership. The underlying thought is that during high unemployment, the alternative for business ownership (i.e. becoming an employee) is not always feasible[1]. Profitability, on the other hand, mainly affects gross entry. Exits are affected by profitability to much less extent. The estimated positive influence of profitability on exit may seem somewhat strange. A high level of profitability can be seen as an incentive to stay in business. The lag length of five years may cause the (limited) positive effect, partly as a result of increased entry.

The calculated gross entry and exit development for the period 1967-1996 is plotted in Figure 8. The entry and exit for the estimated period (1987-1996) fits the data well. For the earlier years the net entry fits well, as imposed by equation (2). However, the actual levels of gross entries and exits in those years are not known. The simulated values are also presented as percentages in the stock of businesses in Table 3.

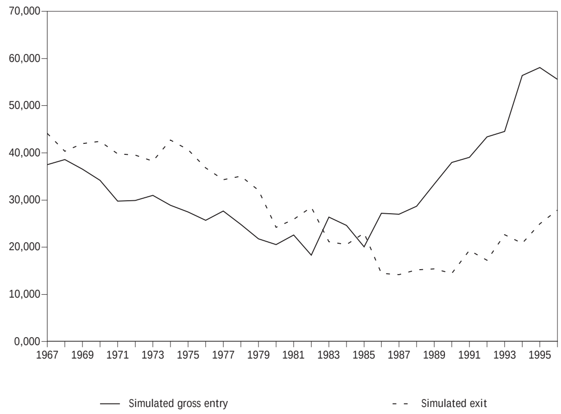
Table 2 Coefficients of the estimated equations*

		Y_DIF (-5)	*SECTOR (-1)*	*PROF_SHR (-5)*	*U_RATE (-5)*	*MIDAGE (-1)*	*Error Correction*	*ΔN / N*
(1)	long-run rate	0.086	0.014					
(2)	short-run rate	0.023	0.028	0.017	0.032	0.407	-0.305	
(3)	turbulence rate		0.037	0.223	-0.148			
(4)	gross entry rate							
	BO / N ≈ 0.07	0.16	0.21	0.23	0.15	2.85	-2.13	0.5
	BO / N ≈ 0.10	0.12	0.16	0.20	0.09	2.04	-1.52	0.5
	BO / N ≈ 0.14	0.08	0.12	0.17	0.04	1.42	-1.07	0.5
(5)	exit rate:							
	BO / N ≈ 0.07	-0.16	-0.18	0.00	-0.30	-2.85	2.13	-0.5
	BO / N ≈ 0.10	-0.12	-0.12	0.03	-0.23	-2.04	1.52	-0.5
	BO / N ≈ 0.14	-0.08	-0.08	0.05	-0.19	-1.42	1.07	-0.5

* The variables *Y_DIF, SECTOR and MIDAGE* enter equations (2)-(5) in first differences.

1 See Iyigun and Owen (1998).

Figure 8 Simulated gross entry and exit development*



* The turbulence rate equation is estimated for the period 1987-1996. For the preceding period the same coefficients have been assumed.

Table 3 Simulated rates of net entry, gross entry, exit and turbulence for 1967-1996

Year	Net entry	Gross entry	Exit	Turbulence
1967	-1.04	5.83	6.86	12.69
1968	-0.28	6.01	6.29	12.29
1969	-0.85	5.71	6.56	12.27
1970	-1.32	5.46	6.79	12.25
1971	-1.65	4.88	6.54	11.42
1972	-1.60	5.00	6.60	11.61
1973	-1.24	5.29	6.53	11.81
1974	-2.39	4.99	7.38	12.38
1975	-2.32	4.83	7.15	11.97
1976	-2.00	4.61	6.61	11.22
1977	-1.23	5.08	6.30	11.38
1978	-1.91	4.64	6.55	11.18
1979	-1.96	4.14	6.11	10.25
1980	-0.69	3.91	4.60	8.51
1981	-0.63	4.29	4.92	9.21
1982	-1.95	3.50	5.45	8.95
1983	1.01	5.09	4.08	9.17
1984	0.78	4.75	3.97	8.72
1985	-0.57	3.88	4.45	8.33
1986	2.43	5.20	2.77	7.97
1987	2.42	5.11	2.68	7.79
1988	2.52	5.35	2.83	8.19
1989	3.30	6.14	2.84	8.98
1990	4.17	6.73	2.56	9.29
1991	3.38	6.69	3.31	9.99
1992	4.28	7.11	2.83	9.93
1993	3.44	7.00	3.56	10.56
1994	5.33	8.44	3.11	11.56
1995	4.73	8.31	3.57	11.88
1996	3.78	7.59	3.81	11.40

4.4 Interdependence between entry and exit

It is generally being acknowledged that entry induces exit through displacement and failed start-ups. On the other side, exit induces entry through replacement. See for example Carree and Thurik (1996), Fotopoulos and Spence (1998) and Bosma *et al.* (1999b).

In our proposed framework, these interaction relations are not shown directly. However, they do exist in the model as a result of the error correction and the time varying coefficients. We already encountered the following equation:

$$NET_t = \frac{N_t}{SE_{t-1}} \Delta BO\_RATE_t + \frac{N_t - N_{t-1}}{N_{t-1}}.$$

The error correction is a linear component of ΔBO_RATE, as we saw in equation (2). Following from equations (4) and (5), each contribution of the error component to the entry rate and the exit rate is given by:.

$$ENTRY_{t+2}^{error} = -\frac{1}{2}\frac{N_{t+2}}{BO_{t+1}} 0.305\left(\frac{BO_t}{N_t} - \frac{BO_t^*}{N_t}\right) = \frac{1}{2}\frac{N_{t+2}}{N_t} 0.305\left(\frac{BO_t^* - BO_t}{BO_{t+1}}\right)$$

$$EXIT_{t+2}^{error} = \frac{1}{2}\frac{N_{t+2}}{BO_{t+1}} 0.305\left(\frac{BO_t}{N_t} - \frac{BO_t^*}{N_t}\right) = \frac{1}{2}\frac{N_{t+2}}{N_t} 0.305\left(\frac{BO_t - BO_t^*}{BO_{t+1}}\right).$$

We will now study the consequences of an increase in the entry rate in year *t*. The first consequence is the change in the stock of businesses:

$$BO_{t+1} = BO_t(1 + ENTRY_t - EXIT_t) .$$

This implies for the error components of entry in t + 2:

$$(6) \qquad ENTRY_{t+2}^{error} = \frac{1}{2}\frac{N_{t+2}}{N_t} 0.305\left(\frac{BO_t^* / BO_t - 1}{1 + ENTRY_t - EXIT_t}\right),$$

and similarly for exit:

$$(7) \qquad EXIT_{t+2}^{error} = \frac{1}{2}\frac{N_{t+2}}{N_t} 0.305\left(\frac{1 - BO_t^* / BO_t}{1 + ENTRY_t - EXIT_t}\right).$$

We see that the key issue is whether the current business ownership rate is below or above the long-run rate. To start from the simplest case, assume that the observed rate equals the long-run rate in period *t*. In this case, a higher entry rate does not have any effect on the exit rate in two years. If the direct effect induces the observed rate to exceed the long-run rate for $t + 1$, however, the effect in $t + 3$ will be negative for the number of entries and positive for the number of exits.

If the business ownership rate is above the long-run rate, the error correction component of exit is positive. Now, an increase in entry reduces the exit rate two years later. This may seem strange, as one would expect to have more exits considering the level of business ownership exceeding the long-term rate. However, notice that when the number of exits remains constant and the number of businesses has risen in the same period, the exit rate gets smaller by definition. This is also called the denominator effect. We can make the argument clear by showing that the number of exits does not change when we derive exits in numbers (instead of in rates):

$$N\_EX_{t+2}^{error} = \frac{1}{2}\frac{N_{t+2}}{N_t} 0.305 \left(\frac{1 - BO_t^* / BO_t}{1 + ENTRY_t - EXIT_t} \right) BO_t (1 + ENTRY_t - EXIT_t)$$

$$N\_EX_{t+2}^{error} = \frac{1}{2}\frac{N_{t+2}}{N_t} 0.305\,(BO_t - BO_t^*) \cdot$$

We see that the number of exits only depends on the development of the labour force and the divergence between the actual and long-term (equilibrium) rates. The rise in entry rates will probably result in an even larger discrepancy, inducing the number of exits (relative to labour force) to rise. Equation (7) reveals that the exit rate then tends to rise as well, but there may also be effects from the entry and exit rates observed in period $t+1$.

If the business ownership rate is below the long run-rate, the error correction component of exit is negative and an increase in entry induces less exit two years later (the component becomes less negative). Again, this is mainly caused by the direct consequence, i.e. the increase of the stock of businesses. Such dynamics will probably cause the actual business ownership rate to be driven towards the long-term rate. Following from equations (6) and (7), this will result in an increase of the exit rate and a decrease of the entry rate.

The general picture for an increase in entry is that the exit rates will first decline by definition. Then – freezing the effects of entry and exit in the next period and the development of the long-term business ownership rate – exit rates tend to increase and entry rates tend to decrease. Recursively, when a year is characterised by a high exit rate, the model expects higher entry rates for the future. These effects are higher when the business ownership rate is lower, as can be seen in Table 2.

The effects discussed above are direct interactions between entry and exit. When the interactions are modelled using simultaneous equations of gross entry and exit (rates), they tend to be overestimated and this will come at the cost of the importance of the other assumed determinants. The cause of the overestimation is multicollinearity, due to high correlation between entry and exit. The direct interaction effects estimated in our model can be interpreted as consequences of market characteristics. *If* there is enough 'room for entrepreneurship' (that is, the observed number of businesses is below equilibrium) *then* an exit creates more opportunities for new business (replacement) and an entry will induce lower exit (displacement or start-up failure). The other interaction effects take place through the assumed determinants.

We may conclude that the problems on simultaneity and symmetry – often encountered in estimating gross entry and exit – are solved by our modelling approach, without neglecting the interaction between the inflow and outflow of businesses. Gross entry and exits can be derived from net entry and turbulence – that are probably the most interesting indicators in the view of policy makers – directly. Furthermore, our approach takes care of the so-called denominator effect (the denominator being determined partly by the numerator) encountered using entry and exit rates.

4.5 Discussion

In this chapter we developed a framework to estimate entry and exit. We chose not to estimate entry and exit directly as is usually done. Difficulties like simultaneity and symmetry typically appear in these kinds of estimations, which hampers obtaining proper estimation results. Moreover, using the obtained estimates for simulations of the business ownership rate in the future often results in improbable (high or low) values.

The approach taken in this chapter is using the short-run equation for the business ownership rate (as estimated in chapter 3) and combining this with a turbulence equation estimation to obtain gross entry and exit implicitly. Our approach implies that, through the error correction mechanism, entry and exit are geared in such a way that the business ownership rate will remain within certain bounds with respect to the underlying equilibrium. We are now ready to develop some macro-economic scenarios, which will be done in the next chapter.

5 Explaining past and future of business ownership

5.1 Introduction

With the model derived in the previous chapters, we can interpret past developments and explore the future. There are several reasons for doing this. It is important for policy makers to have some clue about what direction the level of business ownership is going to take. Will the economic circumstances – as reflected by assumed values for the exogenous variables – provide a situation where the short-run business ownership rate adjusts well to the long-term equilibrium rate? If not, what could be the reason? Is something missing in the model or should the government conduct certain policy to 'set things straight'?

In section 5.2, the model outcomes are compared with the actual development of the business ownership rate. Explanations for the observed pattern can be provided. In section 5.3 a reference scenario for future development is presented, whereas in the subsequent section an alternative scenario is explored.

5.2 Interpretation of the past developments of business ownership

To see the contribution of the determinants in the model, we plotted these one for one against the change in business ownership rates: see appendix IV. We can use the charts to explain the observed behaviour of the business ownership rate (as reflected by Figure 1 and Figure 2) in the Netherlands during the period 1961-1996.

In the 1960s, the business ownership rate fell. The negative value of the change in the business ownership rate was – following the model – mainly due to the low unemployment rate. A modest revival in 1967 is largely explained by a change in the sector characteristic variable. This underlying upward tendency (the rate still fell) was reversed two years later. The income differences were being strongly diminished in this period.

The income differences continued to diminish in the 1970s. Government policy was not promoting entrepreneurship in this period. A decreasing profit share also reflected this. Unemployment started to rise, which has a negative effect on exit in our model.

The post-war baby-boom generation reached the middle-aged category around 1982. This results in the value of 1983 for the change in the business ownership rate to be over-estimated. The effect of the baby-boom generation does seem to be present, witness the actual development from 1982 to 1985. In 1985, the first increase in business ownership since 1960 is observed. The decrease in the two following years may be explained by a temporary setback after the largest bulk of the 'baby-boom entrepreneurs' had started their businesses. At the same time, the growth of the services sector relative to manufacturing declined.

The error correction as estimated by the model is relatively large (and positive) in the early nineties. This conforms to the notion that the rate of business ownership was too low in the mid-eighties. At the end of the eighties, the negative development of the business ownership rate was reversed. The increasing business ownership rate was mainly explained by a combination of increasing profit shares and the rise of the services sector. It was reinforced by the income differences that tended to increase, while it was somewhat tempered by the decreasing unemployment[1]. Observed net entry rates are larger than the estimated ones. This may be the result of the efforts of the Dutch government to reduce barriers towards starting (nascent) entrepreneurs.

5.3 Reference scenario for the future of business ownership

Assumptions for the developments of the determinants

Table 4 presents our projection for the long-run development of the business ownership rate. We expect that the income differences will continue to rise modestly. This expectation is based on the recent developments. Also, the service sector is expected to continue its growth.

As both determinants (income differences and sector structure) are expected to increase, so does the long-run equilibrium rate. We can now assume values for the other determinants, included in the short-run equation. These are found in Table 5. The annual error correction is calculated from *Z(-2)*, the lagged difference between the simulated short-run rate and the long-run rate[2].

1 Though the falling unemployment rate reduces business ownership according to the model, there is more behind this, as the falling unemployment rate may very well be caused by the increasing business ownership.

2 The simulated short-run business ownership rate for 1997-2010 is defined as the sum of the simulated value from the previous year and the estimated change using the short-run equation. The simulated value for 1996 is set equal to the actual value.

Table 4 Assumed values of *YDIF and SECTOR* for the future and the simulated long-run equilibrium rate*

Year	*YDIF(-5)*	*SECTOR(-1)*	Simulated equilibrium rate (long-run equation)
1997	0.211	2.696	0.1081
1998	0.203	2.788	0.1071
1999	0.222	2.834	0.1130
2000	0.229	2.881	0.1154
2001	0.234	2.927	0.1178
2002	0.239	2.973	0.1192
2003	0.244	3.019	0.1212
2004	0.249	3.065	0.1231
2005	0.254	3.111	0.1250
2006	0.259	3.157	0.1269
2007	0.264	3.203	0.1288
2008	0.269	3.250	0.1307
2009	0.274	3.296	0.1325
2010	0.279	3.342	0.1344

* The values of *YDIF(-5)* are given a small annual increase of 0.005 from 2000 onwards. The annual increase of *SECTOR(-1)* is assumed equal to half of the increase between 1996 and 1997.

Table 5 Assumed values of the independent variables entering the short-run equation*

Year	*ΔMIDAGE(-1)*	*ΔY_DIF(-5)*	*U_RATE(-5)*	*PROF_ SHARE(-5)*	*ΔSECTOR(-1)*
1997	0.00371	-0.0158	0.05212	0.1523	0.1031
1998	0.00387	-0.0087	0.06364	0.1361	0.0923
1999	0.00428	0.0199	0.07385	0.1731	0.0461
2000	0.00385	0.0067	0.06942	0.1817	0.0461
2001	0.00324	0.0050	0.06555	0.1719	0.0461
2002	0.00291	0.0050	0.05386	0.1900	0.0461
2003	0.00314	0.0050	0.03046	0.1710	0.0461
2004	-0.00154	0.0050	0.03546	0.1631	0.0461
2005	-0.00103	0.0050	0.04046	0.1631	0.0461
2006	0.00000	0.0050	0.04546	0.1631	0.0461
2007	0.00130	0.0050	0.05046	0.1631	0.0461
2008	0.00117	0.0050	0.05546	0.1631	0.0461
2009	0.00069	0.0050	0.06046	0.1631	0.0461
2010	-0.00042	0.0050	0.06546	0.1631	0.0461

* The values of *YDIF(-5)* and *SECTOR(-1)* were already defined in Table 4. The change in the share of middle-aged people is taken from prospects of the Dutch Central Bureau of Statistics. The unemployment rate is assumed to rise slightly after 1999, which means that *U_RATE(-5)* is expected to rise after 2003. The profit share is forecast until 2000. *PROF_SHARE(-5)* is assumed to be constant after 2004.

Results and explanations

Figure 9 shows the development of the simulated equilibrium business ownership rate (from the long-run equation) and the simulated actual rate (from the short-run equation). The simulated actual rate is expected to be above the simulated equilibrium rate until 2000 and below afterwards. In 2010, the simulated equilibrium business ownership rate takes on a value of 13.4%, while the simulated actual rate is 12.8%. The general picture for the simulation period is that the business ownership rate keeps growing, though at a lower pace. This is reflected in Table 6 as well, where we can see the future development of gross entry and exit.

The decline in 2003-2005 is caused by a number of factors. The expected share of middle-aged people is declining in these years, while the effect of the decreasing unemployment and decreasing profit shares at present have negative influences as well.

The typical pattern of entry and exit is that when they move away from each other in some period, they come closer in the next period. Thus, the directions are mainly opposite. This has two reasons. First, as Table 2 indicates, most coefficients have opposite signs for gross entry as compared to exit. Second, the interaction between entry and exit through the error correction effect makes a period of increasing annual gross entry to have a positive effect on the number of exits some years later (and vice versa). This was already explained in section 4.4.

Figure 9 Simulated values of the equilibrium business ownership rate and simulated values of the actual business ownership rate for 1997-2010, using the reference scenario

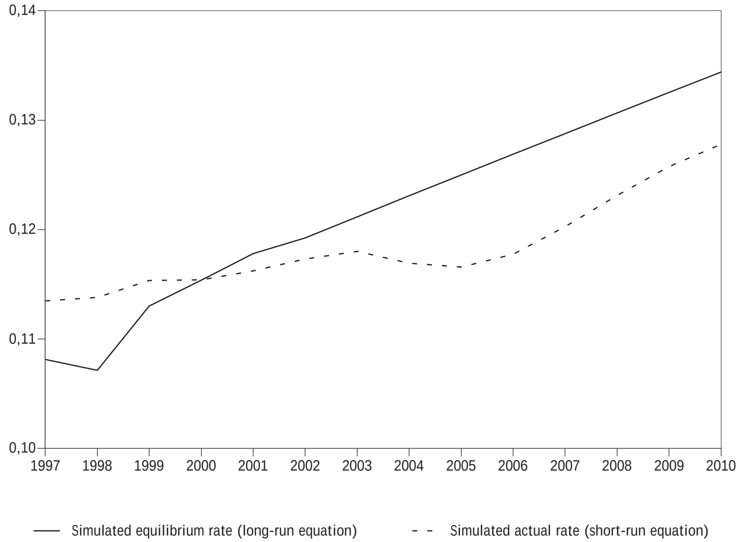


Table 6 Simulated rates of net entry, gross entry, exit and turbulence for 1997-2010, reference scenario

Year	Net entry	Gross entry	Exit	Turbulence
1997	2.03	6.47	4.44	10.92
1998	0.59	5.49	4.90	10.39
1999	1.66	6.36	4.70	11.06
2000	0.32	5.81	5.49	11.30
2001	1.83	6.46	4.63	11.10
2002	2.04	6.84	4.80	11.64
2003	1.69	6.53	4.84	11.37
2004	0.15	5.64	5.49	11.14
2005	0.77	5.93	5.16	11.09
2006	2.05	6.55	4.50	11.05
2007	3.21	7.11	3.90	11.01
2008	3.43	7.20	3.77	10.97
2009	3.18	7.05	3.87	10.93
2010	2.65	6.77	4.12	10.88

5.4 Alternative scenario

In this section we simulate the model for the future, changing (some) assumptions for the future values of the exogenous variables. Different assumptions for exogenous variables may affect both the long-run simulation and the short-run simulation.

Decreasing profit shares, diminishing income differences

It is conceivable that, as a reaction on the prosperity of the late nineties in the Netherlands, wages will increase more rapidly and the profit shares of business owners will decrease. Suppose that this will go together with stabilising income differences. What will then be the estimated future picture of Dutch business ownership? Both adjustments are expected to have a negative effect on the number of business owners relative to labour force. We can explore the consequences by adjusting the assumptions of the data for the future.

Assume that the profit share decreases with 0.005 (instead of being stable) annually from 2000 onwards. Also, for the period 1996-2005, the income differences are expected to be equal to the value of 1995.

The simulation for the 1997-2010 period is depicted in Figure 10 and Table 7. Simulating the model – using the estimated coefficients – yields a simulated equilibrium business ownership rate of 12.2% and a simulated actual rate of 11.7% in 2010. The fact that these figures are lower than in the reference scenario is not surprising, as the alternative scenario assumptions are less favourable to business ownership. The lower net entry rate is explained by both gross entry and exit: compared to the reference scenario, entry rates are lower and exit rates are higher. Turbulence rates are also lower, indicating that the above mentioned differences in gross entry rates are larger than the differences in exit rates. Gross entry rates are lowest in 2004 and 2005. Exit rates are relatively high in these years, resulting in negative net entry.

Figure 10 Simulated values of the long-run business ownership rate, and simulated values of the short-run business ownership rate for 1997-2010, deviant scenario

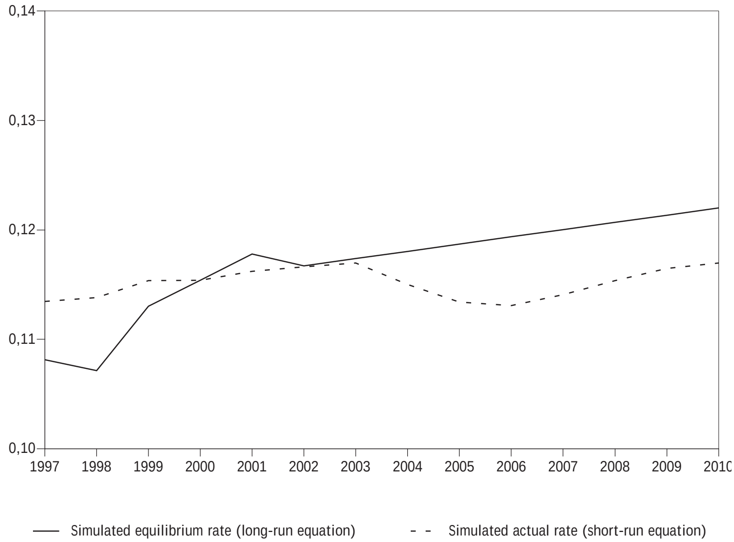


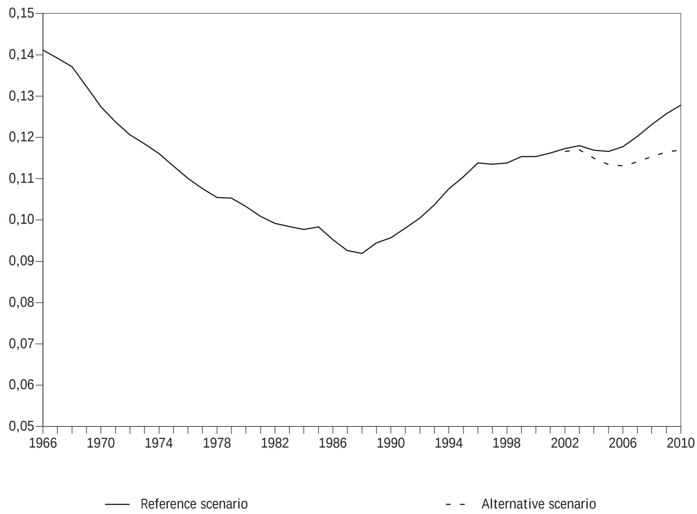
Table 7 Simulated rates of net entry, gross entry, exit and turbulence for 1997-2010, deviant scenario

Year	Net entry	Gross entry	Exit	Turbulence
1997	2.03	6.47	4.44	10.92
1998	0.59	5.49	4.90	10.39
1999	1.66	6.36	4.70	11.06
2000	0.32	5.81	5.49	11.30
2001	1.83	6.46	4.63	11.10
2002	1.44	6.54	5.10	11.64
2003	1.40	6.39	4.98	11.37
2004	-0.63	5.25	5.88	11.14
2005	-0.35	5.31	5.66	10.97
2006	0.78	5.79	5.01	10.81
2007	1.92	6.28	4.36	10.64
2008	2.18	6.33	4.15	10.48
2009	1.97	6.14	4.17	10.32
2010	1.45	5.80	4.35	10.15

6 Future research

In chapter 5 we presented two scenarios for future development of the business ownership rate. These are plotted in Figure 11. With predictions of the labour force, this may be used to predict the expected number of business owners. The business ownership rate in the reference scenario is expected to continue its growth, at a smaller pace, however. The deviant scenario shows a more or less stable business ownership rate for 2000-2010. As the labour force is expected to increase, this implies for both scenarios that the number of business owners will rise. General picture of both scenarios is that the exit rates rise towards the level of the entry rates until 2004 and then drop again.

Figure 11 Business ownership rates 1966-2010*



* Observed values for 1966-1996. Simulated values for 1997-2010, using two scenarios.

We observed that the short-run (actual) rate trails behind the long-run (equilibrium) rate in the reference scenario (and the alternative scenario). This suggests that some additional determinants of (future) business ownership may be missing from the model. The efforts of the Dutch government to reduce the barriers to entry may be one of those determinants. Further, there are indications that business ownership now attracts an increasing amount of younger people (see van Gelderen, 1999, and van der Kuip, 1999). The high immigration rate in the Netherlands can also be reinforcing. A high number of migrants (high density), for instance in the urban regions, can stimulate migrants to create their own social structure, which requires entrepreneurship (van den Tillaart and Poutsma, 1998). Future research will have to focus on incorporating such missing variables.

Another improvement may be to disaggregate the model in sectors, using a top-down approach. Incorporating specific characteristics of specific sectors in the present model will make the total picture of business ownership development both more precise and more complete.

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Appendix I: Data

Table I.1 Time series data for the Netherlands. The definitions and sources are given below

YEAR	BO_RATE	TURB	Y_DIF	SECTOR	PROF_SHARE	U_RATE	MIDAGE
1960	0.161	.	0.473	0.792	0.258	0.005	0.236
1961	0.158	.	0.463	0.795	0.228	0.005	0.235
1962	0.155	.	0.453	0.803	0.218	0.005	0.234
1963	0.153	.	0.446	0.811	0.200	0.005	0.232
1964	0.151	.	0.439	0.817	0.201	0.005	0.231
1965	0.146	.	0.405	0.827	0.194	0.004	0.229
1966	0.141	.	0.373	0.858	0.166	0.007	0.229
1967	0.139	.	0.345	0.906	0.173	0.015	0.228
1968	0.137	.	0.330	0.937	0.179	0.013	0.227
1969	0.132	.	0.316	1.013	0.205	0.008	0.226
1970	0.127	.	0.302	1.048	0.189	0.008	0.224
1971	0.124	.	0.294	1.112	0.155	0.012	0.223
1972	0.121	.	0.285	1.187	0.161	0.021	0.223
1973	0.118	.	0.277	1.229	0.158	0.023	0.223
1974	0.116	.	0.259	1.272	0.120	0.027	0.224
1975	0.113	.	0.242	1.341	0.055	0.039	0.224
1976	0.110	.	0.235	1.439	0.085	0.042	0.225
1977	0.108	.	0.228	1.508	0.072	0.040	0.224
1978	0.105	.	0.224	1.580	0.081	0.040	0.225
1979	0.105	.	0.221	1.638	0.060	0.038	0.226
1980	0.103	.	0.209	1.698	0.046	0.041	0.227
1981	0.101	.	0.196	1.771	0.044	0.060	0.229
1982	0.099	.	0.190	1.845	0.047	0.088	0.236
1983	0.098	.	0.185	1.926	0.069	0.116	0.242
1984	0.098	.	0.201	1.998	0.104	0.112	0.247
1985	0.098	.	0.218	2.029	0.112	0.096	0.251
1986	0.095	.	0.220	2.054	0.137	0.085	0.254
1987	0.093	0.0076	0.222	2.107	0.130	0.078	0.257
1988	0.092	0.0074	0.209	2.128	0.154	0.076	0.261
1989	0.094	0.0081	0.219	2.144	0.185	0.067	0.264
1990	0.096	0.0089	0.216	2.163	0.188	0.057	0.268
1991	0.098	0.0099	0.227	2.200	0.171	0.053	0.271
1992	0.100	0.0102	0.211	2.243	0.152	0.052	0.275
1993	0.104	0.0109	0.203	2.336	0.136	0.064	0.278
1994	0.108	0.0126	0.222	2.483	0.173	0.074	0.282
1995	0.110	0.0136	0.229	2.593	0.182	0.069	0.286
1996	0.114	0.0130	.	2.696	0.172	0.066	0.289

A dot means that these data are not available.

Definitions

BO_RATE: Business ownership rate (number of business owners relative to labour force). The rates of 1960-1970 are rough estimates. The number of business owners includes incorporated and unincorporated businesses. Participating family members are not counted. *Source: EIM (number of self-employed), CBS (labour force).*

TURB: Turbulence rate (gross entry plus exit, divided by the number of businesses at the beginning of the year). The rates are only known for the period 1987-1997. *Source: EIM.*

Y_DIF: Income differences, measured by the Gini coefficient as calculated on the development of income levels. The Gini coefficient undergoes the double negative logarithm transformation. *Source: CBS.*

SECTOR: Employment of the services sector (excluding transport and hotels & restaurants) related to employment in manufacturing. *Source: CBS.*

PROF_SHARE: Profit share: the share of the complement of wages in total value added. *Source: CPB (including predicted values until 2000).*

U_RATE: Unemployment rate: number of unemployed related to labour force. *Source: CBS.*

MIDAGE: Share of people aged 35-54 in total population. *Source: CBS. (Projections for the future are available as well).*

Appendix II: Cointegration technique

Cointegration deals with modelling time series in a specific way. Time series often show stochastic trends. If so, the series are said to be non-stationary. Regressing non-stationary time series may result in finding significant effects while the effects just stem from the time aspects of the series and not from interdependence. In the effort to get rid of non-stationarity, time series are transformed by applying first differences.

If a series must be differenced d times before it becomes stationary, then it contains d unit roots and is said to be integrated of order d, denoted $I(d)$. Consider two time series y_t and x_t, which are both $I(d)$. In general, any linear combination of the two series will also be $I(d)$ (for example: the residuals obtained from regressing y_t on x_t are $I(d)$. If, however, there exists a vector β, such that the disturbance term u_t from the regression $y_t = \beta x_t , + u_t$ is of a lower order of integration, $I(d-b)$, where $b > 0$, then Engle and Granger (1987) define y_t and x_t as cointegrated of order (d,b).

The economic interpretation of cointegration is that if two (or more) series are linked to form an equilibrium relationship spanning the long run, then even though the series themselves may contain stochastic trends (i.e. be non-stationary) they will nevertheless move closely together over time and the difference between them will be stable (i.e., stationary). Thus the concept of cointegration mimics the existence of a long-run equilibrium to which an economic system converges over time, and u_t defined above can be interpreted as the equilibrium error (see Harris, 1996).

Following directly from the identification of cointegration with equilibrium, it is possible to make sense of regressions involving non-stationary variables. If these are cointegrated, then regression analysis imparts meaningful information about long-run relationships, whereas if cointegration is not established we return to the subject of spurious correlation. Cointegration is very closely linked to the use of short-run error correction models, thus providing a useful and meaningful link between the long- en short-run approach to econometric modelling.

From the brief introduction above it becomes clear that a well-fit cointegration analysis must fulfil two conditions.

1. All time series variables must have the same order of integration[1].
2. The residuals of the estimated long-run relationship must have a lower order of integration.

Both conditions can be tested empirically by means of the Dickey-Fuller approach (Dickey and Fuller, 1979). We have data on the number of enterprises, the income per capita and the Gini coefficient measuring the differences of income distribution from 1960 to 1996. Also variables measuring the unemployment, profitability, the share of people aged 35-54 in the population and the employment share of the services relative to manufacturing are available for this time period.

Step 1: Establishing the orders of integration

First, the order of integration of each variable has to be established. To investigate the order of integration for each time series *TS*, the following regression is estimated:

(a) $$\Delta TS_t = \mu + \gamma t + (\rho - 1)TS_{t-1} + u_{it} \qquad u_{it} \sim IID(0, \sigma_i^2).$$

If it is known that the mean of the time series is equal to zero and that there is no time trend, equation (a) can be estimated without these additional characteristics (μ and γ are set equal to zero). Equation (a) is estimated with ordinary least squares. However, the critical values are different than the ones that are commonly used in plain ordinary least squares estimations[2].

A richer test would be to use the Augmented Dickey Fuller (ADF) test, in which *TS* follows an AR*(p)* process instead of an AR*(1)* process. However, this test cannot be applied in our case as the sample size is too short; percentage points of their distributions will not in general be the same as for those applicable under the strong assumptions of the simple Dickey Fuller model (Banerjee *et al.*, 1993, p. 106).

Step 2: Long-run equation and cointegration test

Having established the orders of integration for each variable, the long-run equation may be stated and estimated. The series of the

1 An exception may be the case when the dependent variable is *I(1)*, whereas some independent variables may be *I(2)*. Those *I(2)* variables may co-integrate to an *I(1)* variable and then the specification is still justified.
2 See Dickey and Fuller (1979).

long-run equation are cointegrated if the residuals of the long-run equation have an order of integration that is lower than the order of integration of the variables that enter the long-run equation. Again, specific critical values are to be used that are supplied by MacKinnon (1991).

Step 3: Short-run equation and error correction modelling

The estimated long-run relationship now guides the direction for the short-run relationship. This is done by regressing the annual changes of the dependent variable on the residuals of the long-run equation, apart from the other assumed determinants[1]. The annual change of the dependent variable is assumed to be partly related to the extent of non-correspondence between the estimated value and the realised value. An overestimation of the long-run rate leads to positive adjustment of the short-run rate – which makes (other things being equal) the short-run rate move towards the long-run rate.

1 These commonly include the first differences of the determinants in the long-run relationship, but may include additional variables as well.

Appendix III: A model for business ownership participation

This section contains a model for business ownership participation that is set up by Parker (1996). We chose not to use this exact model, but it provides some support for our approach taken.
Denote business ownership by *BO* and hired employment by *HE*. We want to maximise discounted lifetime utility, subject to the constraint that income growth depends on the expected returns from participation in *BO* and *HE*, and on the balance of time allocated to each. It is hypothesised that uninsurable risk is assumed to be concentrated in the business ownership sector.
Denote the current-period wages in sector *i* by w_i and let θ describe the proportion of time that is allocated to *HE*. Normalising to unity, income *y* is equal to:

$$y = w^{BO}\vartheta + w^{HE}(1-\theta);$$
$$\dot{y} = \dot{w}^{BO}\vartheta + \dot{w}^{HE}(1-\theta).$$

The growth rate of the wage in sector *i* equals $g_i = \dot{w}_i / w_i$. Assume that this growth rate and income vary proportionately. Denote the coefficients of proportionality by λ^i. It follows that income growth is:

$$\dot{y}/y = w^{BO}\lambda^{BO}\vartheta + w^{HE}\lambda^{HE}(1-\theta).$$

The risk is implemented by variation in w^{BO}:

$$\mathrm{d}w^{BO} = \sigma(y)\mathrm{d}z,$$

where z is a Wiener process, and σ^2 is the variance per unit time of this stochastic process. We may write $\sigma(y) = \sigma^* y$, with σ^* a risk parameter. Using the chain rule, the stochastic component of the change in income is $\theta\sigma^* ydz$. Total budget constraint is:

(I) $$\mathrm{d}y = \left[(w^{BO}\lambda^{BO}\vartheta + w^{HE}\lambda^{HE}(1-\vartheta))y\right]\mathrm{d}t + \theta\sigma^* y\mathrm{d}z.$$

In order to solve the individual's problem, assume that the utility function is concave. We choose θ such that the expected *intertemporal* (not the instantaneous) utility

(II) $$E\int_0^\infty u(y)e^{-rt}\,\mathrm{d}t$$

is maximised subject to (I) and the boundary condition $y(0) = y_o$, where r is the individual's rate of time preference and E is the expectation operator. The optimal solution is given by:

$$\text{(III)} \qquad \theta^* = \frac{w^{BO}\lambda^{BO} - w^{HE}\lambda^{HE}}{\gamma\sigma^{*2}},$$

where $\gamma > 0$ is the relative risk aversion parameter in the utility function.

We now have the individual's optimal balance between business ownership and hired employment when agents are homogeneous and able to engage in both sectors simultaneously. Accounting for heterogeneity in endowments of managerial skills alters the equation into the following:

$$\text{(IV)} \qquad \ln\left[-\ln(BO/N)_t\right] = -\ln\left|(1-\tilde{\theta})\gamma\right| - 2\ln\sigma_t{}^* + \ln\Phi_t.$$

In this equation, $\tilde{\theta}$ is the normalised value of a minimum-hours constraint. Worker j will be a business owner when $\theta_j^* > 1-\tilde{\theta}$. The mean value of the wedge $\xi_j(w^{BO}\lambda^{BO} - w^{HE}\lambda^{HE})$ is denoted by Φ.

Like equation (III), the business ownership rate will be greater when the expected wedge between business ownership income and hired employment is greater. The risk in the returns from business ownership and the degree of risk aversion affect the business ownership rate negatively. The double negative logarithm transformation applied to the business ownership rate in equation (IV) is monotonic and does not alter the interpretations. This is illustrated by the outcome of the regression with the transformation on the business ownership rate:

1') *BO_RATE'* = 0.340 *Y_DIF(-5)* + 0.0557 *SECTOR(-1)* - 0.803
(17.7) (5.89) (-68.2)

R^2_{adj} = 0.97
DW = 0.53

(2') Δ *BO_RATE'* = 0.093 *ΔY_DIF (-5)* + 1.608 *ΔMIDAGE (-1)* + 0.079 *PROF_SHR (-5)* +
(2.19) (2.38) (3.35)
0.126 *U_RATE(-5)* + 0.119 *ΔSECTOR (-1)* - 0.322 *ERROR_CORR (-2)* - 0.028
(2.68) (3.52) (-3.27) (-5.07)

R^2_{adj} = 0.81
DW = 1.91.

The estimated coefficients are all about four times higher with respect to the estimates of the equations without transformation. The range spanning observed values of the self-employment rate is around four times smaller than the range of their double negative logarithms. Thus, the outcomes are comparable.

Appendix IV: Contributions of the independent variables to the change in the business ownership rate

Figure IV.1 Contribution of the change in the income distributions *(ΔY_DIF)* to the change in the business ownership rate *(ΔBO_RATE)* as estimated by the short-run equation

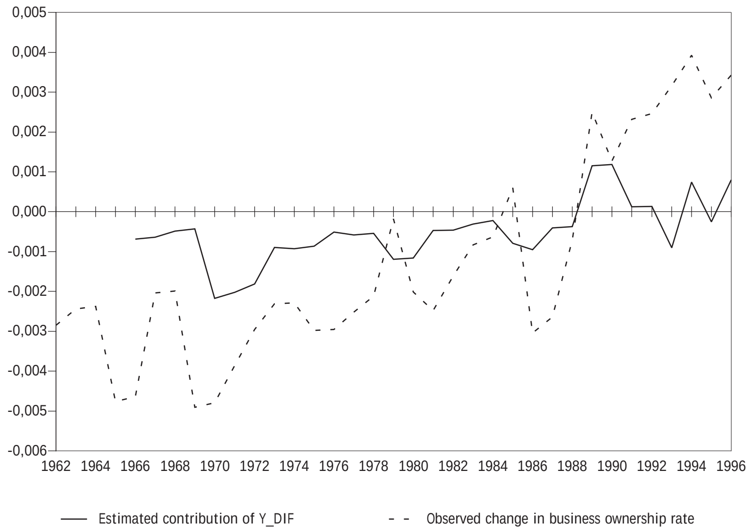


Figure IV.2 Contribution of the change in the share of middle-aged people (DMIDAGE) to the change in the business ownership rate (DBO_RATE) as estimated by the short-run equation

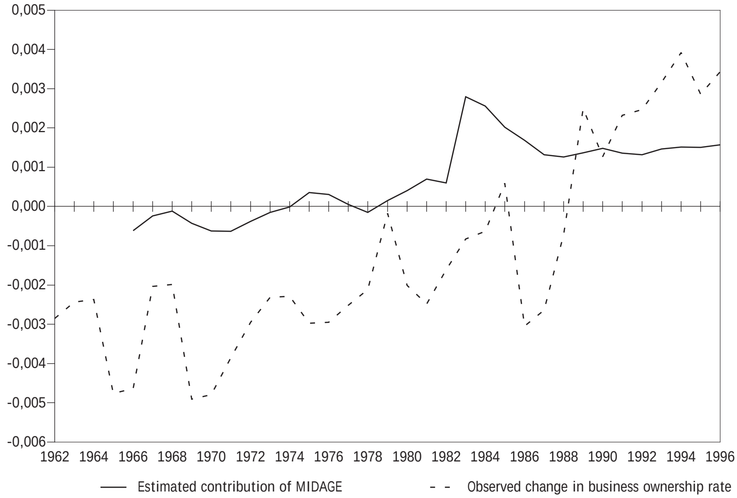


Figure IV.3 Contribution of the unemployment rate (U_RATE) to the change in the business ownership rate (DBO_RATE) as estimated by the short-run equation

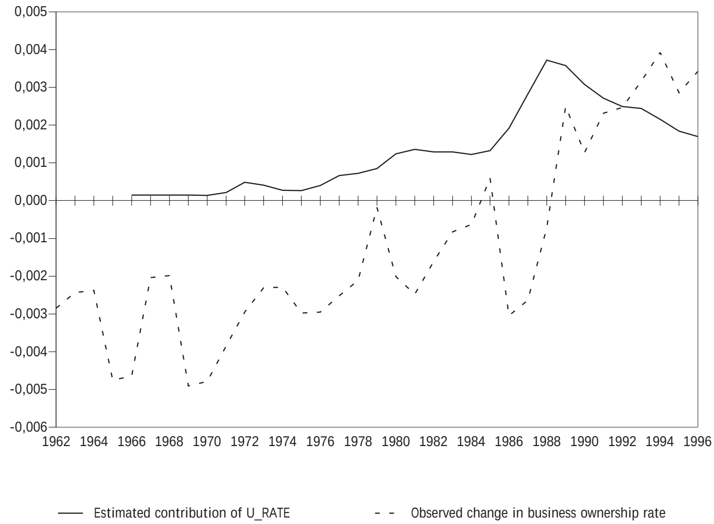


Figure IV.4 Contribution of the profit share (PROF_SHARE) to the change in the business ownership rate (ΔBO_RATE) as estimated by the short-run equation

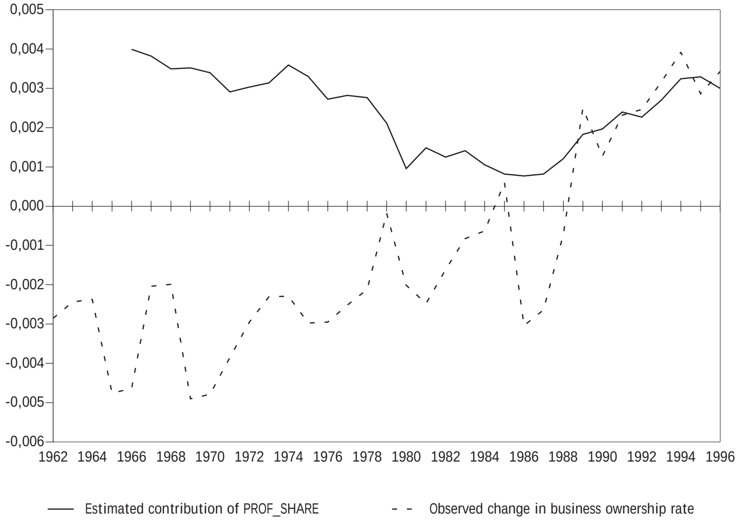


Figure IV.5 Contribution of the change in sector structure (ΔSECTOR) to the change in the business ownership rate (ΔBO_RATE) as estimated by the short-run equation

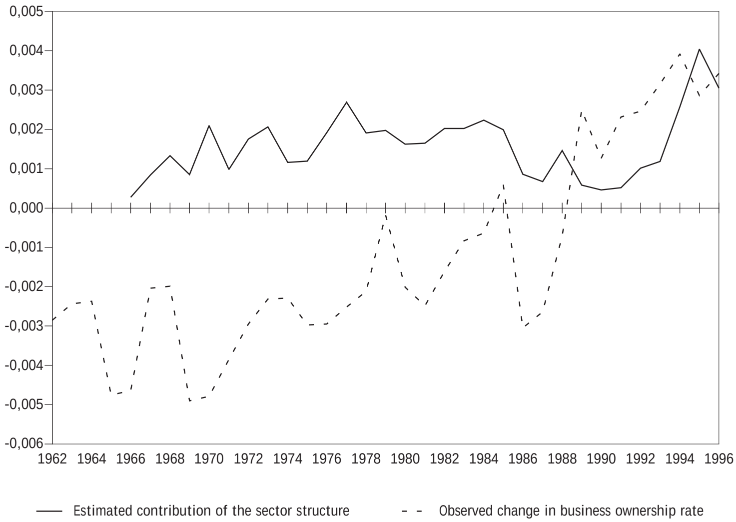
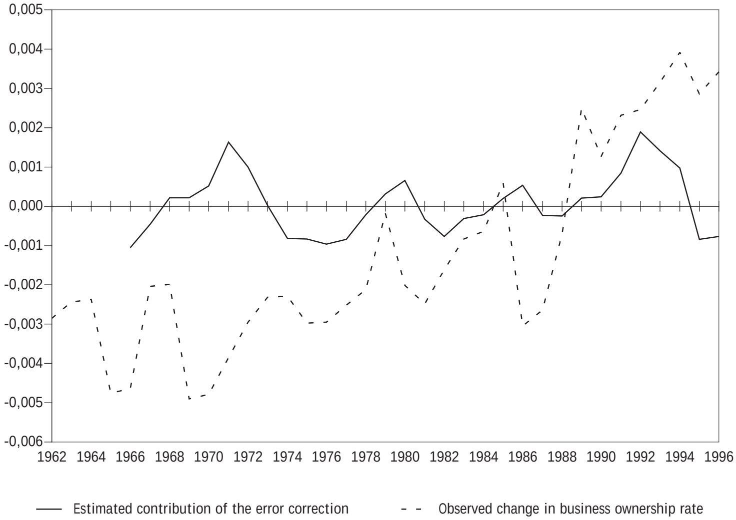


Figure IV.6 Contribution of the change in sector structure (ERR_CORR) to the change in the business ownership rate (ΔBO_RATE) as estimated by the short-run equation



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/A: a report of one of the other business units of EIM/Small Business Research and Consultancy;
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