Job Creation and Destruction in Taiwan

Liu De-Chih B.Sc (M.Sc)

Doctor of Philosophy

August 2009

STATEMENT OF ORIGINALITY

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying subject to the provisions of the Copyright Act 1968.

ACKNOWLEDGEMENT

I owe a great debt to my supervisors Bill Mitchell and Martin Watts, who suggested the subject, advised and encouraged my study in Australia. The many hours they spent in discussing the issues of this thesis have been immeasurable help. I am also grateful to other staff members at the University of Newcastle, especially Victor Quirk (CofFEE), Riccardo Welters (James Cook University), James Juniper (CofFEE), Sally Cowling (CofFEE), Beth Cook (CofFEE), Anthea Bill (CofFEE), Frank Agbola (Newcastle Business School), Gorica Trajkovic (CofFEE) and Melinda Hannan (CofFEE).

I wish to express my sincere appreciation of the invaluable suggestions and comments to Robert J. Dixon (Department of Economics, Facility of Economics and Commerce, The University of Melbourne) and Scott T. Fullwiler (James A Leach Chair in Banking and Monetary Economics, Social Entrepreneurship Program Director, Department of Business Administration and Economics, Wartburg College, Waverly, IA, USA). Thanks to the participants at the 18th PhD conference in Economics and Business, and seminar at the University of Newcastle.

I am heavily indebted to Martin Watts for assistance in the final stage of this thesis. Thanks also go to Elizabeth Williams, Fiona Madden and Kerri Foulds. I would like especially to thank Bill Mitchell for the financial support.

This thesis would not have been possible without considerable personal support. I am very grateful to my parents, mother-in-law and grandmother for their boundless support and encouragement while I was struggling with the writing of the thesis.

Finally, I am greatly indebted to my wife Stella Tseng and my loving daughter BM for emotional support.

Table of Contents

Tables

Tables (cont)

Tables (cont)

Figures

Figures (cont)

Acronyms and Abbreviations

ABS	Australian Bureau of Statistics
ACF	Auto-Covariance Function
AIC	Akaike Information Criteria
APEC	Asian-Pacific Economic Cooperation
AR	Auto-Regressive
ARMA	Auto-Regressive Moving Average
AREMOS	Advanced REtrieval MOdeling System
ARIMA	Auto-Regressive Integrated Moving Average
BEVT	Bureau of Employment and Vocational Training
BLS	Bureau of Labour Statistics
BLS	Business Longitudinal Survey
CBT	Central Bank of Taiwan
CEPD	Council for Economic Planning and Development
CLA	Council of Labour Affairs
CPS	Current Population Survey
DMI	Dun and Bradstreet Market Identifier
EM	Expectation Maximisation
EX	Excess Job Reallocation
GARCH	Generational Autocorrelation Conditional Heteroskedasticity
GDP	Gross Domestic product
GNP	Gross National Product
HSIP	Hsinchu Science-based Industrial Park
IRF	Impulse Response Function
LRD	Longitudinal Research Database
LTS	Labour Turnover Surveys
MA	Moving Average
MCMC	Markov Chain Monte Carlo
ML	Maximum Likelihood
MS	Markov Switching
MS-AR	Markov Switching Autoregression
MS-ARX	Markov Switching Autoregression with Exogenous Variable

Acronyms and Abbreviations (cont)

MS-VAR	Markov Switching Vector Autoregression
MS-SVARs	Markov Switching Structural Vector Autoregression
MSM-AR	Markov Switching Autoregression with Mean regime-dependent
MSI-AR	Markov Switching Autoregression with Intercept regime-dependent
MSIH-AR	Markov Switching Autoregression with regime-dependent Intercept and Heteroscedasticity
MSIH-ARX	Markov Switching Autoregression with Intercept and Heteroscedasticity regime-dependent and Exogenous Variable
NBER	National Bureau of Economic Research
NET	Net Employment Change
NETS	National Establishment Time Series
NID	Normally and Independently Distributed
NIE	Newly Industrialising Economy
NP	Non-Parametric test
OECD	Organization for Economic Co-operation and Development
SBA	Small business Administration
SC	Schwarz Criterion
SIC	Standard Industrial Classification
SMEA	Small and Medium Enterprises Administration
SMEs	Small and Medium Enterprises
SEE	Survey on Earnings of Employees
STSP	Southern Taiwan’s Science Park
VAR	Vector Autoregression
VARMA	Vector Auto-Regressive Moving-Average
JC	Gross Job Creation
JD	Gross Job Destruction
JR	Job Reallocation
WRIS	Workplace Industrial Relations Survey

Abstract

This thesis explores the behaviour of job flows in Taiwan. The investigation of the behaviour of job creation and destruction has improved our understanding of the dynamics of the Taiwanese labour market and also has important implications in terms of economic research and policymaking.

Chapter 2 discusses the basic features of the overall post-war Taiwanese economy. We find that large flows of workers enter and exit the employment pool. The large worker flows offer an interesting insight about the job flow dynamics. Based on the measures proposed in Chapter 3, Chapter 4 carefully examines the so-called small business job creation hypothesis. We find that small business can be viewed as the engine of job creation. However, small business is not the source of sustained increases in employment. Chapter 5 documents the basic features of job creation and destruction. We find that job creation is more volatile than job destruction in the manufacturing and service sectors, but reveals the opposite pattern in the construction sector. Based on the methodologies outlined in Chapter 6, Chapter 7 investigates the regime switching and asymmetric behaviour of job creation and destruction. We find that the interest rate can help to explain the asymmetric behaviour of job creation and destruction rates in all sectors. Furthermore, we find an interesting feature that a lower interest rate stimulated beneficial regime shifts in job flows. Chapter 8 explores the similarities and differences of regional business cycles by reference to the employment growth rate as well as job creation and destruction rates. We find that the regime switching behaviour of employment growth was similar across the North, Central and South regions. However, behaviour in the East Region was dramatically different. Furthermore, the regime switching behaviour of the common regional business cycle (specified in terms of employment growth) is consistent with the business cycle indicator proposed by Council for Economic Planning and Development (CEPD).

Chapter 1 Introduction

1.1 Introduction

Understanding the behaviour of job creation and destruction is fundamental to understanding the operation of the labour market. Since the work of Davis and Haltiwanger (1990, 1992) there has been a growing literature on the dynamics of job creation and destruction, and their relationship to the business cycle, regional development, and exogenous shocks (for example, monetary policy).

Previous studies have shown that in labour markets in both advanced and developing countries continual creation and destruction of jobs is occurring as plants expand and contract (Davis and Haltiwanger, 1992; Tsou *et al.*, 2002; Mitchell and Myers, 2007). The time series analysis of job creation and destruction reveals a rich picture of the dynamics of the labour market in comparison to studies that focus on measures of net employment changes over time. For example, the evidences in most advanced and developing countries show that gross flows are large in relationship to net employment changes. Furthermore, while most studies examine the workers' side of the turnover process, the analysis of job creation and destruction enables the development of interesting insights about the demand side of the labour market. Although the current literature has investigated the dynamics of job creation and destruction in advanced economies, with the exception of Tsou *et al.* (2001, 2002); Tsou and Liu (2005), there has been little research undertaken in Taiwan. This thesis aims to fill this gap.

This thesis employs a unique monthly dataset (Survey on Earnings of Employees; SEE), which allows us to explore the time-series behaviour of job creation and destruction within and across years. Furthermore, the quality of the data is such that we are able to present interesting evidences with regard to the dynamics of job creation and destruction from a variety of perspectives such as establishment size, industry sector and geographical location.

In Taiwan, there has been a longstanding belief that small and medium enterprises (SMEs) were the fountainhead of job creation and hence economic growth. As a consequence, preferential policy treatment in favour of SMEs was advocated as a way of reducing the unemployment rate in Taiwan. For example, the Taiwanese government implemented a Small and Medium Enterprises Manpower Project during the recession (December 2000 to March 2002). However, the wage subsidy scheme for SMEs was unsatisfactory because most employees left their positions on the expiration of the subsidisation period. The job-creating prowess of SMEs has been questioned by researchers, but they have adopted different methodologies to examine this question. We will employ the SSE dataset to address these issues in detail in Chapters 2, 3 and 4.

Previous studies have documented the large gross worker flows between labour market states (employment, unemployment, out of the labour force). These flows offer an interesting parallel to the job flow dynamics. When a firm closes a plant and destroys jobs, workers are forced to enter the unemployment pool or leave the labour force. When a firm creates jobs, workers may move from other firms or from the unemployment pool or from not in the labour force status to fill the positions. However, a component of the worker flow out of employment results from voluntary resignation for a variety of reasons, such as health, schooling and retirement. We will explore the basic features of job creation and destruction as well as the connection between worker and job flows in detail in Chapters 5. We will then introduce the econometric and statistical methods that underpin the empirical work which is conducted in later chapters to investigate the dynamic of job creation and job destruction in Taiwan.

Between 1987 and 2003, the Taiwanese economy was confronted by two significant economic shocks, the first caused by the Asian financial crisis, and the second induced by the recession (December 2000 to March 2002). These shocks have influenced the nature and intensity of the restructuring of the Taiwanese economy. The unemployment rate rose from 2.69 in 1997 to the peak of 5.17 in 2002 (Statistical Yearbook of Taiwan, 2002).

During the Asian financial crisis and the 2001 recession, the Central Bank of Taiwan (CBT) actively intervened in financial and labour markets to reduce the damage to the real economy arising from the economic turmoil. For example, the Taiwanese government reduced the discount rate 11 times over the period of the 2001 recession which was designed to stimulate investment (Yu, 2003). We are interested in whether the active intervention of the CBT during the Asian financial crisis and the 2001 recession introduced asymmetric behaviour into job creation and destruction processes in Taiwan. The asymmetric behaviour of macroeconomic aggregates might arise because an economy reacts differently to positive shocks (such as monetary policy) and negative shocks (Sichel, 1993; Beaudry and Koop, 1993). We will address this issue in detail in Chapter 7.

In the last decade, a number of researchers have explored the cyclical properties of job reallocation and its relationship to worker turnover from a sectoral perspective. However, with the exception of Davis *et al.* (1996b) and Essletzbichler (2004) in the US; Essletzbichler (2007) in the UK, there has been limited research about the dynamics of job creation and destruction across regions. The study of job flow activity across regions has important implications for regional policy making and the dating of the overall business cycle. If cyclical characteristic in a particular region is largely unrelated to other regions, a more focussed regional policy might be appropriate. If, however, most regions share a common business cycle, a more centralised policy (for example, monetary policy) is warranted.

The exploration of the relationship between regional cyclical fluctuations and the national business cycle would help in the understanding the fluctuation of aggregate economy. Although Taiwan's business cycle has been explored in a number of studies (for example, Huang *et al.*, 1998; Chang, 2004), little is known about the features of regional business cycles. As a result, the final aim of this thesis is to explore the characteristics of regional business cycles. This topic will be addressed in detail in Chapter 8.

1.2 Structure of the thesis

The thesis will be structured as follows. The purpose of the Chapter 2 is to provide a context for the later chapters which explore job dynamics in the Taiwanese labour market. We initially outline the post-war growth and per capita growth performance of the Taiwanese economy and examine the fluctuations of employment and unemployment over the business cycle and the flows of workers into and out of the employment pool. Moreover, we discuss the Public Service Employment Program and the preferential treatment for small business.

In Chapter 3 we describe their characteristics of the data and outline the construction of the measures employed throughout the Thesis.

In Chapter 4 we review and critique the available research evidence from international studies. Furthermore, we formally outline the small business job creation hypothesis. Finally, we employ three different measures to examine the small business job creation hypothesis based on the manufacturing, service and construction sectors.

Chapter 5 documents the basic features of job creation and destruction. After a review of previous studies, we will examine the cyclical sensitivity of job creation and job destruction rates across sectors and investigate the relationship between worker turnover and job reallocation in Taiwan. Finally, we will explore the features of job creation and destruction across regions in Taiwan.

Chapter 6 outlines the econometric and statistical methods that are employed in the Chapters 7 and 8. These methodologies include the estimation of univariate and multivariate Markov-switching autoregressive (MS-AR) models; analysis using Pearson’s contingency coefficient, Fisher’s exact test and nonlinear impulse response analysis. These methodologies are suitable for the task at hand and provide different insights into the time series dynamics of job creation and destruction.

Based on the methodologies proposed in Chapter 6, Chapter 7 outlines the formal asymmetry tests based on the MS-AR model. Also, we will explore the regime switching behaviour of job creation and destruction as well as the evidence for asymmetries. Should evidence of asymmetries be found we will examine if monetary policy can help to explain the asymmetric behaviour of job creation and destruction.

Chapter 8 explores the similarities and differences of regional business cycles by reference to the (net) employment growth rate as well as job creation and destruction rates, for which graphical analysis, simple correlation coefficients, the univariate Markov switching autoregression model, Pearson’s contingency coefficient and Fisher’s exact test are employed. Furthermore, a multivariate Markov switching autoregression model is then employed to identify a common regional business cycle in Taiwan. The Council of Economic Planning and Development (CEPD) defined chronologies are taken as the benchmark for comparison purposes.

Chapter 9 summarises the main findings, as well as limitations, of the thesis. We also outline possible directions for further research in Chapter 9.

1.3 The chief findings of the thesis

In this thesis, we explore how job creation and destruction differ by establishment size, industry sector and geographical location. We investigate the empirical basis for conventional claim about the job-creating prowess of small business. We also explore the asymmetric behaviour of job creation and destruction and the characteristics of regional business cycles. Our chief findings and conclusions fall into five categories.

In Chapter 4, we show that previous studies reported results from two different versions of the small business job creation hypothesis, one of which was expressed in terms of a comparison of rates and the other in terms of a comparison of shares. We find that the two versions of the small business job creation hypotheses can be reconciled, as long as we take account of the (net) job creation share relative to its corresponding employment share.

The empirical results in Chapter 4 finds support for the small business job creation hypothesis across all three sectors. Thus small business can be viewed as the engine of job creation. However, small business also destroys jobs in disproportionate numbers, which is revealed by the analysis of net job creation. Thus small business is not the source of sustained increases in employment. This finding suggests that policy makers should be very cautious about implementing preferential treatment for small business.

In Chapter 5, we explore the basic features of job creation and job destruction in terms of sector and region. We find that job creation is more volatile than job destruction in the manufacturing and service sectors, but reveals the opposite pattern in the construction sector. Thus, in Taiwan, there is limited support for the hypothesis of countercyclical job reallocation. Furthermore, worker turnover in the service sector is more dynamic than in the manufacturing and construction sectors, which implies more efficient job matching in the former. Finally, the North Region is more dynamic than the other three regions (Central, South, and East Regions), as revealed by job reallocation representing a lower share of worker turnover.

In Chapter 7, we find evidence of asymmetries in the job creation and destruction rates. Moreover, we find that the interest rate can help to explain the asymmetric behaviour of job creation and destruction rates in all sectors. Furthermore, we find that a lower interest rate stimulated beneficial regime shifts in job flows. This coincidence in time does not directly prove that monetary policy impacts on job creation and destruction. We do not deny the possibility that the easing of monetary policy could have been associated with other factors which promoted the beneficial regime shifts. As a result, we tentatively conclude that discretionary monetary policy in Taiwan has a significant influence on the cyclical behaviour of job creation and destruction.

Finally, Chapter 8 finds that the regime switching behaviour of employment growth is similar in the North, Central and South Regions, but is dramatically different in the East Region. Furthermore, using the multivariate MS-VAR model, Chapter 8 finds that the regime switching behaviour of the common regional business cycle (specified in terms of employment growth) is consistent with the CEPD business cycle indicator. This finding suggests that the common regional business cycle would help to identify the turning points after the 1990s. An index of employment growth in combination with other indicators (for example, output growth) would help to monitor fluctuations and identify the turning points of the business cycle of the aggregate economy.

Chapter 2 The Post-War Taiwanese Economy

2.1 Introduction

The purpose of this Chapter is to examine the operation of the post-war Taiwanese economy. We outline the post-war growth and per capita growth performance and examine the fluctuations of employment and unemployment over the business cycle and the flows of workers into and out of the employment pool. Moreover, we discuss employment and employment growth across regions in Taiwan which assists in the understanding of the regional industrialisation process. Finally, we discuss the Public Service Employment Program and the preferential treatment for small business during the recession (December 2000 to March 2002). This relatively unsuccessful preferential policy motivates us to examine the small business job creation hypothesis. This Chapter provides a context for the later chapters which explore gross job dynamics in the Taiwanese labour market.

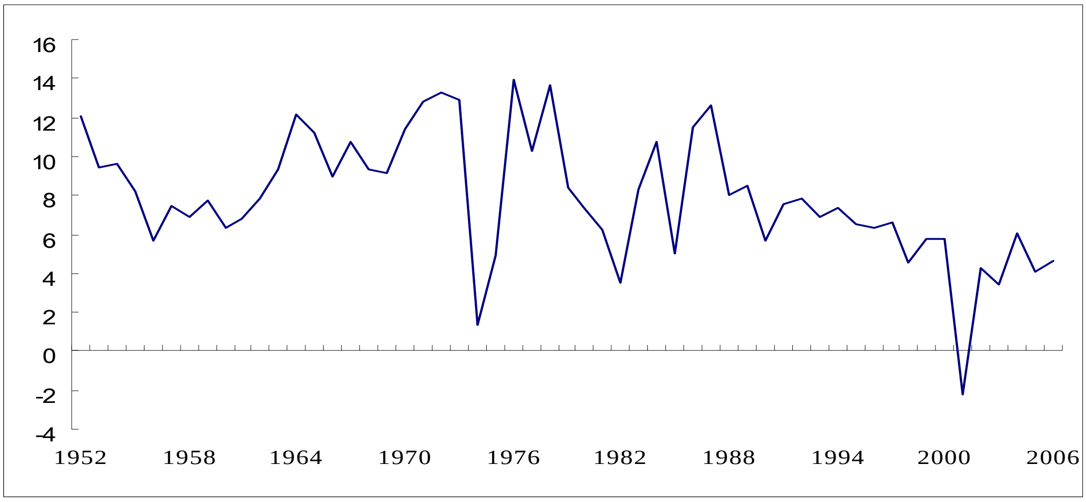
The remainder of this Chapter is organised as follows. In Section 2.2 we analyse trends in output and employment between 1952 and 2006. Section 2.3 examines the regional labour market in Taiwan. We then introduce the Public Service Employment Program and the Small and Medium Enterprises (SMEs) Manpower Project in Section 2.4. Section 2.5 concludes.

2.2 Output and employment 1952-2006

By the end of 2005, Taiwan's population stood at 22,770,383. With an average of 629 persons per square km[1], Taiwan is the second most densely populated area in the world. Like many other developed countries (and most notably Japan), Taiwan, is also becoming an "aging society", with people over the age of 65 years representing 7 per cent of the total population (Statistical Yearbook of Taiwan, 2006).

In the 1970s, the Taiwanese economy underwent a transformation whereby its earlier reliance on light industry gave way to an increased dominance of heavy industry. In the last decade industrial restructuring has continued and now high-tech electronics is a major industry. The government currently implements measures, such as revise and relax laws and regulations[2], which aim to help the service sector to create high value added. These initial structural transformations were associated with Taiwan's trade deficits turning into trade surpluses during the 1970s. The trade balance in 1971 was 0.16 billion US dollars (2.5 per cent of GDP) in surplus and had increased to 21 billion US dollars (19.8 per cent of GDP) by 1987. However, after 1987, these surpluses gradually diminished. In 2006, the trade surplus was 17.1 billion US dollars (4.8 per cent of GDP). The main imports were machines, electronic devices and plastics, and the main exports were electronic devices, machines, chemicals and steel. During the last two decades, the leading export markets have been the US and Japan; and the largest sources of imports were Japan, the US and Germany. By 2006, however, China had overtaken the US to become Taiwan's largest export market and its second-largest source of imports after Japan (Taiwan New Economy Newsletter, 2006).

Figure 2.1 Annual economic growth rate in Taiwan, 1952-2006.

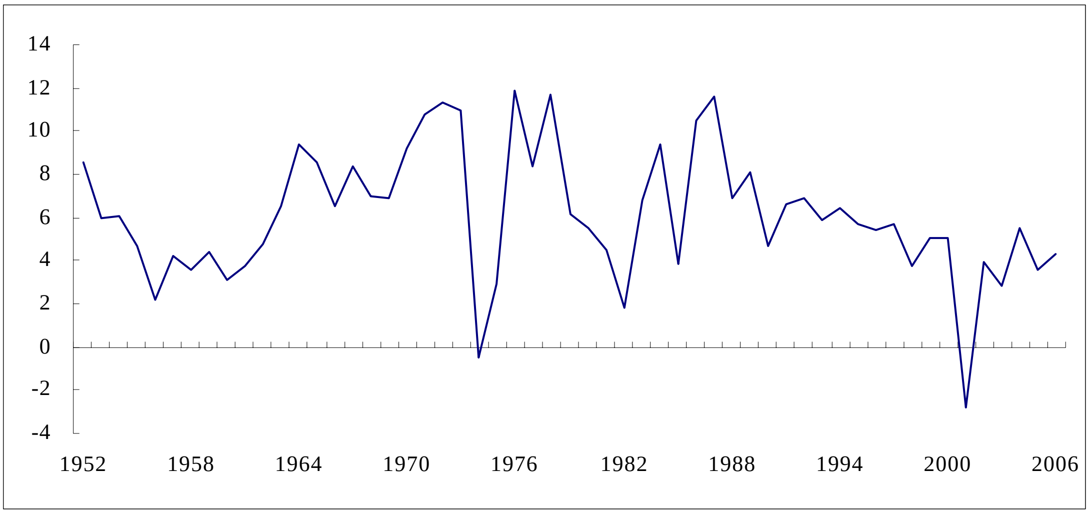


Source: Taiwan Statistical Data Book, 2007.

Figures 2.1 presents Taiwan's growth rate from 1952 to 2006. Except for a sharp recession in 1974 and 1975[3], Taiwan experienced rapid economic growth in the post-war period until 1978. Since peaking in 1976, annual GDP growth has exhibited a long-term decline.

Figures 2.2 depicts Taiwan's real GDP per capita growth rate from 1952 to 2006. Although the population growth rate exhibited a long term decline from 3.5 per cent in the 1950s to 0.9 per cent in the 1990s[4], the real GDP per capita growth rate exhibits a similar pattern to the growth rate. Since peaking in 1976, annual real GDP per capita growth has also exhibited a long-term decline. Due to the recession in 2001, the real GDP per capita growth rate fell by 2.3 percent.

Figure 2.2 Real GDP per capita growth rate in Taiwan, 1952-2006.



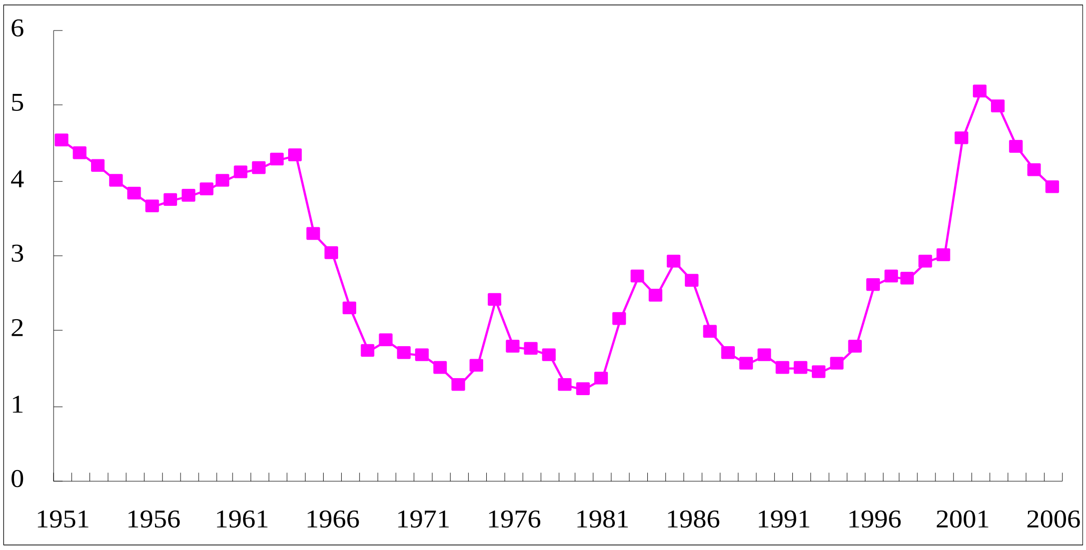
Source: Taiwan Statistical Data Book, 2007.

Since the start of economic liberalisation[5] in the late 1980s, the Taiwanese industrial structure has exhibited rapid change. Prior to 1987, Taiwan enjoyed an average 8.5 per cent GDP growth during the expansionary periods, and even a rate of 5.5 per cent during periods of contraction[6]. After 1988, the average GDP growth rate fell to 5.5 per cent and 2.5 per cent in the expansionary and recessionary phases, respectively.

Following two years of economic recovery from the shock of the Asian financial crisis with growth rates in 1999 and 2000 of 5.42 and 6.26 per cent, respectively, the Taiwan economy was pushed into recession[7] in 2001 with output falling by 2.2 percent. The main reasons for the collapse in the growth rate were the global economic recession, dwindling domestic investment, and the adjustment of its domestic industrial structure[8], which caused Taiwanese exports and industrial output to drop sharply (Taiwan New Economy Newsletter, 2002). A mild recovery has occurred since then.

Figure 2.3 reports the annual unemployment rate from 1951 to 2006. During the 1950s, the relative high unemployment rate was partly due to the influx of Chinese refugees[9]. In the late 1960s, Taiwan experienced a declining unemployment rate. In the 1970s, the annual unemployment rate remained below 2 per cent[10]. Moreover, the unemployment rate remained below 3 per cent during the 1980s, despite the oil price shocks in 1983 and 1985. In the mid 1990s, the unemployment rate started to rise, reaching 5 per cent in 2002.

Figure 2.3 The annual unemployment rate in Taiwan, 1951-2006.



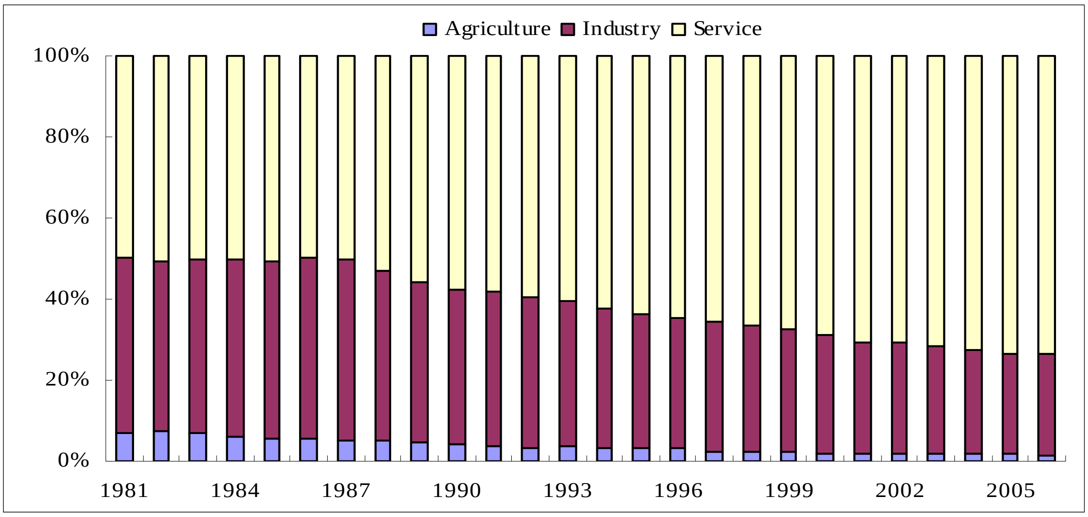
Source: Council of Labour Affairs, 2007.

The increase in the unemployment rate can, in part, be traced to the dramatic changes in industry structure over the period 1980-2000 (Shu and Zeng, 2006; Chiao and Hung, 2006). In 1979, China commenced the process of economic reform. China tried to combine central planning with market-oriented reforms. The market-oriented reforms which have been implemented over the past two decades have unleashed individual initiative and entrepreneurship. China is now the fourth-largest economy in the world. It has sustained average economic growth of over 9.5 per cent for the past 26 years

(Shu and Zeng, 2006). China's ongoing economic transformation has had a profound impact on Southeast Asian countries, and other trading partners including Australia.

Taiwan has endured significant pain in relation to its restructuring efforts for two main reasons. First, the huge pool of cheap labour in China has attracted export-oriented multinational firms, which have provided strong competition to Taiwanese exporters. Second, the unique links with China, both as a trading partner[11] and through the so-called Chinese connections[12], have led to the flight of Taiwanese labour-intensive industries to China (Shu and Zeng, 2006).

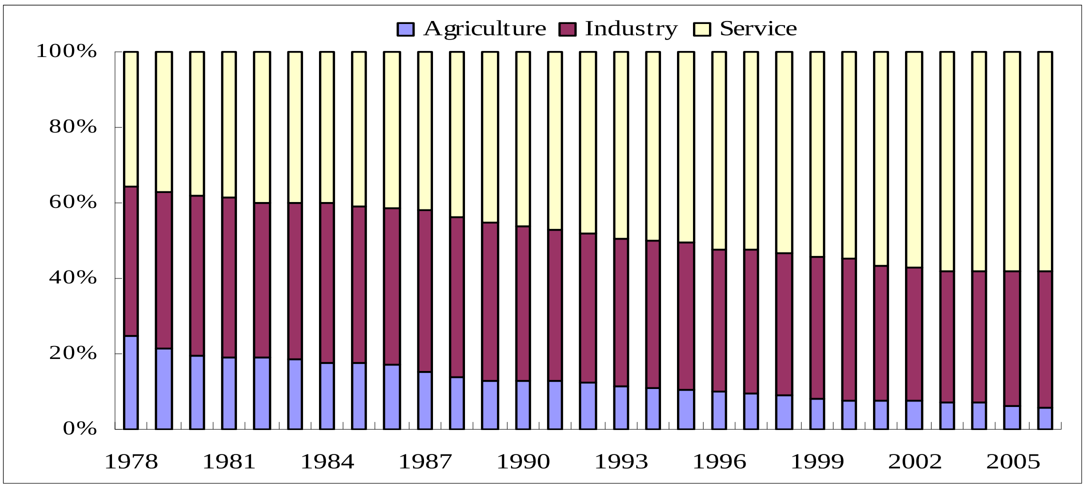
Figure 2.4 Sectoral shares of GDP, 1981-2006.



Source: Taiwan Statistical Data Book, 2007.

Figure 2.4 shows the shares of gross domestic product (GDP) by sector from 1981 to 2006. In 1981, the service sector (Utility, Wholesale, Transportation, Finance, Industrial Service and Social Service) was responsible for 50 per cent of GDP. By 2006 this proportion had increased to 73 per cent. The share of the industrial sector[13] (Mining, Manufacturing and Construction) declined over the same period, although less than the increase in the service sector, due to the simultaneous decline in the share of agriculture. As a result of these sectoral shifts, the economic base in Taiwan has shifted from the industrial sector to the services sector.

Figure 2.5 Sectoral shares of employment, 1978-2006.

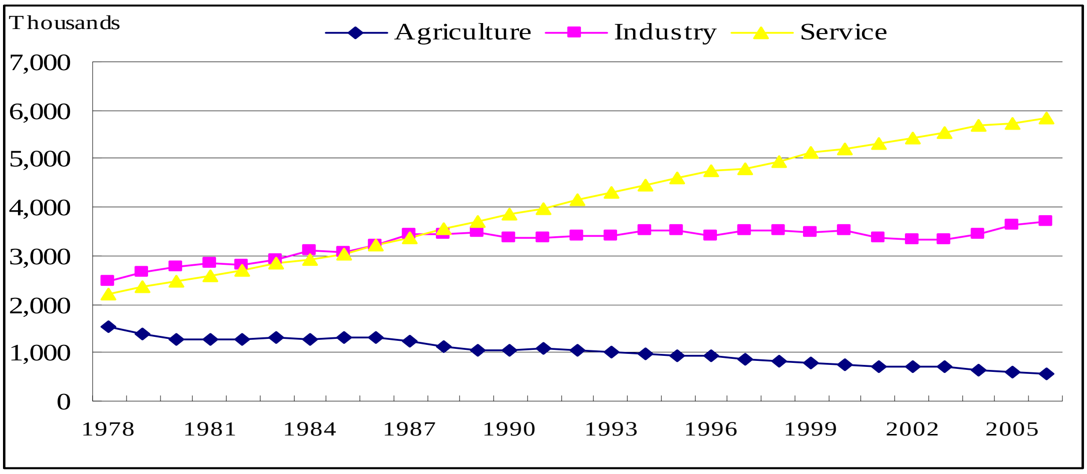


Source: Taiwan Statistical Data Book, 2007.

The pattern of structural change in Taiwan also can be revealed by examining the corresponding employment shares by sector (Figure 2.5). The employment share of the low productivity agricultural sector fell from 25 per cent in 1978 to 6 per cent in 2006. The employment share of the industrial sector increased gradually from 39 per cent in 1978 to 43 per cent in 1987 and then declined to 36 per cent in 2006. The employment share of the service sector increased from 36 per cent in 1978 to 58 per cent in 2006.

Figure 2.6 shows the level of employment by sector between 1987 and 2006. The number of employees in the service sector increased at an annualised rate of 4 per cent over the period 1978 to 2006. In contrast, the level of employment in the industry sector has fluctuated around 3.5 million since 1986. Employment in the agriculture sector decreased from 1.55 million in 1978 to 554 thousand in 2006. These data confirm that Taiwan has evolved to a service sector dominated economy.

Figure 2.6 Employment by sector, 1978-2006.



Source: Taiwan Statistical Data Book, 2007.

Table 2.1 reports the sectoral shares of GDP and employment expressed as percentages by country in 2002. While Taiwan is on a par with Japan with respect to the service sector share of GDP, job creation in the service sector is relatively low, mainly because it lags behind other countries in the development of such labour-intensive services as tourism and property management (Directorate-General of Budget, Accounting and Statistics, 2004). Moreover, Table 2.1 also reveals interesting variations in the relative shares of employment and GDP for services and manufacturing. Germany has a relatively productive services sector, so that the service sector has a higher share of GDP than the corresponding employment share. By contrast, Australia, UK and Singapore reveal an opposite picture. US, France and Japan have almost equally productive sectors. Differences in the incidence of part-time employment across sectors and countries would play a role since employment figures are based on 'bodies' not hours.

Table 2.1 Sectoral shares of GDP and employment by countries (%), 2002.

Country	Agriculture		Industry		Service	
	GDP	Employment	GDP	Employment	GDP	Employment
Australia	3.9	4.7	29	21.2	67.2	74.1
China	14.8#	44.1	52.9#	17.7	32.3#	38.2
France	3	3.6	25	23.9	72	72.5
Germany	1	2.5	26.5	31.9	72.5	65.6
Hong Kong	0	0.3	13	18.3	87	81.4
Japan	1.3	4.2#	30.4	28.7#	68.3	67.1#
South Korea	3.2#	8.8#	34.6#	19.1#	62.2#	72.1#
Taiwan	1.8	7.5	27.6	35.2	70.6	57.3
US	1.4	2.6	22	21.8	76.6	75.6
UK	1	1.4	30	24.1	69	74.5
Singapore	0	0.3	34	24.6	66	75.1

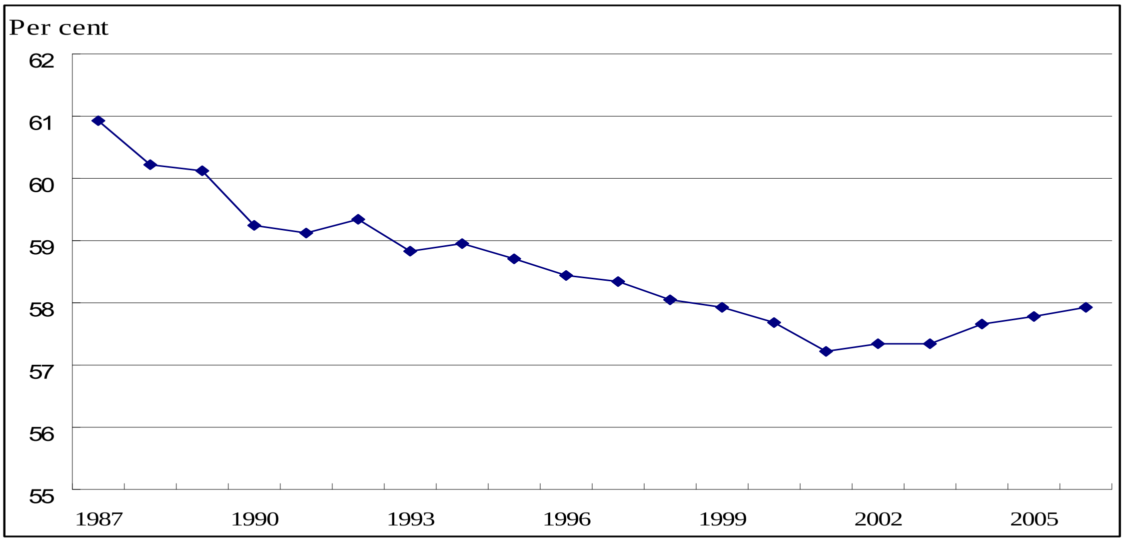
Notes: # represents 2003 figure.
Sources: Directorate-General of Budget, Accounting and Statistics (DGBAS), 2003.
World Competitiveness Yearbook, 2003.
Australian Bureau of Statistics, National Accounts, 2003.

2.3 Gross worker flows into and out of employment

Employment statistics measure employment levels at a point of time, but do not capture the dynamics associated with flows into and out of employment. Layoffs and quits cause transitions from employment to unemployment or not in the labour force status. Flows of workers into employment occur when new workers find jobs after completing education or unemployed workers secure jobs.

Figure 2.7 shows the overall rates of labour force participation. The labour force participation rate showed a systematic decline between 1987 and 2001 (except 1992 and 1994), dropping from 60.93 per cent in 1987 to 57.23 per cent in 2001, but there was a modest increase over the 2002-2006 period. The possible explanation is that the limited employment opportunities lead some of the unemployed to choose to leave the labour force during the 1987-2001 period. For a range of reasons, including age and lack of education etc, they anticipated that they would be unable to secure a job.[14] This is referred to as the discouraged worker effect. Moreover, since 2002 the growth of employment opportunities has lead to an increase in the rate of labour force participation.

Figure 2.7 The labour force participation rate, 1987-2006.



Source: Manpower Survey Database, 2007.

Tables 2.2 and 2.3 present evidence of the large flows of workers into and out of the employment pool, respectively in Taiwan. During the recession in 2001, around 548 thousand workers in the industry sector found jobs. However, around 733 thousand workers in the industry sector left employment. On the other hand, during the upturn in 2004, around 735 thousand and 648 thousand workers in the industry sector entered and left the employment pool, respectively. This evidence suggests that the labour market in Taiwan is in a constant state of flux with jobs continually being created and destroyed as establishments expand, contract or close. These data also indicate a lot of worker movement some of which is voluntary. It should be noted that if a worker quits or is sacked, and then is replaced, this does not signify job destruction, followed by job creation.

Table 2.2 Gross worker flows into employment by age and sector, 2001-2005.

	Total	15-19	20-24	25-29	30-39	40-49	50-59	>60
Industry sector								
2001	548138	20104	116936	179551	153319	60232	15760	2236
2002	669764	23378	148460	229551	181639	69177	15365	2194
2003	717710	23954	146495	244498	204658	76951	19044	2110
2004	734580	23765	155158	249877	204965	79117	19161	2537
2005	738941	19147	137821	250022	215930	91990	21359	2672
Service sector								
2001	716777	62885	205197	224326	150003	55833	15121	3412
2002	771591	63949	214132	239774	176109	55684	18324	3619
2003	854015	63213	223631	276481	198061	70117	20301	2211
2004	879721	68273	223848	284214	203777	74767	22042	2800
2005	1001342	79397	255768	322273	231173	85820	23817	3094

Source: Directorate General of Budget, Accounting and Statistics, 2007.

Table 2.3 Gross worker flows out of employment by age and sector, 2001-2005.

	Total	15-19	20-24	25-29	30-39	40-49	50-59	>60
Industry sector								
2001	732827	20192	108293	186487	209888	121000	58471	28496
2002	635410	22540	118757	196374	155472	81637	39530	21100
2003	656468	14981	95935	184255	200355	97899	45440	17603
2004	647561	13415	102236	187240	194534	91343	44002	14791
2005	705148	14030	100199	204353	215072	106686	48622	16186
Service sector								
2001	847223	66182	191528	232330	222589	88354	33199	13041
2002	731107	51594	170020	213323	174339	70586	32927	18318
2003	796649	54815	163463	223446	213915	87677	37154	16179
2004	785530	55439	164042	221906	206807	83667	40257	13412
2005	915623	57569	179292	271040	246701	101392	44951	14678

Source: Directorate General of Budget, Accounting and Statistics, 2007.

It is also important to stress that the large worker flows out of employment are not due solely to job destruction. Table 2.4 reports on the reasons for people not being employed, which include both being unemployed and out of the labour force because of retirement, giving birth or other house issues[15], for the period 1987 to 2003. Individuals can be classified according to whether they are engaged in their initial job search (for example, school leavers) or searching after a period of employment or after being out of the labour force. Moreover, the reasons for job loss can be further categorised into business closure or contraction, dissatisfaction with the previous job and completion of a temporary job. Out of the labour force status can be attributed to temporary retirement, health problems, and for women being married, child-rearing or childbirth.

The number of unemployed who are classified as searching after a period of employment has tended to increase over time. Up to 1998, the main reason for unemployment was dissatisfaction with the previous job. In a tight labour market with an unemployment rate of less than 2 per cent, a worker could be choosy about her/his job knowing that the period of unemployment was likely to be short. However, the number of people made unemployed by their business closing or contracting almost doubled over 12 months to 206 thousand in 2001 (see Table 2.4). First time labour market entrants also found it hard to get a job in a depressed labour market, and their numbers rose from 58 thousand in 2000 to 75 thousand in 2001. These data confirm that the unemployment problem increased sharply because of the recession between December 2000 and March 2002.

Table 2.4 The reasons for unemployment in Taiwan, 1987-2006 (‘000s).

	Total	[Initial search for job]	[Non-initial search for job]	Business close or contraction	Dissatisfied with previous job	Health issues	Temporary job finished	Female marriage or childbirth	Retired	House issues	Other issues
1987	161	58	104	22	55	4	10	1	1	1	10
1988	139	51	90	17	50	4	8	0	1	1	9
1989	132	46	86	18	49	3	6	1	1	0	8
1990	140	47	92	24	50	3	6	0	0	0	9
1991	130	43	86	21	46	3	8	0	0	0	8
1992	132	46	87	16	49	4	8	0	0	1	9
1993	128	41	87	18	50	3	7	1	0	0	8
1994	142	43	99	19	57	3	9	1	1	0	9
1995	165	47	119	29	66	3	10	1	1	0	9
1996	242	56	187	68	79	5	19	1	2	1	12
1997	256	57	199	71	84	7	22	1	1	1	12
1998	257	59	198	71	82	6	25	1	1	1	11
1999	283	60	224	91	86	6	26	1	1	1	12
2000	293	58	234	90	95	6	29	1	1	1	11
2001	450	75	374	206	88	8	52	2	1	2	15
2002	515	81	435	248	110	9	47	2	2	2	15
2003	503	85	419	228	111	10	50	3	3	2	12
2004	454	85	369	158	131	11	49	3	2	2	11
2005	428	82	346	130	140	11	49	3	3	3	7
2006	411	82	329	117	141	9	44	3	3	2	9

Source: Directorate General of Budget, Accounting and Statistics (DGBAS), 2007.

2.4 Regional labour markets in Taiwan

The first purpose of this section is to document the levels of population and employment across the four regions between 1993 and 2003. Shift-share analysis is then used to classify the divergent patterns of employment change by industry and region between 1991 and 2001 based on Census data (see Appendix).

2.4.1 Population and employment by region 1993-2003

The main island of Taiwan is classified into four regions: North, Central, South and East, which contain seven cites and fifteen counties. Table 2.5 reports population by region from 1993 to 2003. There are a significant regional population differences.

Table 2.5 Population by region in Taiwan, 1993-2003 (‘000s).

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Taiwan	20744	20944	21126	21294	21479	21693	21868	22037	22189	22303	22404
North Region	8381	8463	8544	8621	8721	8856	8975	9087	9184	9258	9330
Taipei City	2673	2651	2646	2618	2596	2621	2640	2646	2640	2636	2632
Keelung City	361	364	367	372	377	380	384	387	390	391	392
Hsinchu City	334	337	339	343	349	354	359	365	371	376	381
Taipei County	3191	3247	3282	3329	3387	3442	3488	3540	3591	3627	3661
Taoyuan County	1433	1467	1505	1547	1594	1634	1673	1713	1749	1778	1808
Hsinchu County	389	397	405	412	418	425	431	436	443	450	456
Central Region	5262	5324	5381	5431	5480	5526	5561	5596	5631	5657	5680
Taichung City	806	825	844	865	890	911	930	954	977	990	1004
Miaoli County	554	557	559	560	560	560	560	560	560	561	561
Taichung County	1336	1366	1394	1417	1438	1458	1476	1488	1498	1507	1516
Changhua County	1269	1277	1285	1290	1294	1300	1303	1308	1312	1315	1316
Nantou County	543	545	546	546	546	546	545	542	541	541	541
Yunlin County	754	754	753	753	752	751	747	744	743	743	742
South Region	6030	6080	6124	6164	6201	6237	6262	6289	6311	6326	6335
Kaohsiung City	1405	1413	1420	1429	1434	1454	1469	1484	1493	1504	1509
Chiayi City	258	259	261	262	263	263	264	266	267	268	269
Tainan City	697	702	705	709	714	719	725	732	738	743	748
Chiayi County	559	563	565	566	566	567	564	562	563	563	561
Tainan Couny	1053	1064	1076	1085	1093	1098	1102	1105	1107	1107	1107
Kaohsiung County	1155	1172	1187	1201	1218	1224	1228	1232	1236	1233	1236
Pintung County	903	907	910	912	913	912	910	908	907	908	905
East Region	1071	1077	1077	1078	1077	1074	1070	1065	1063	1062	1059
Taitung County	255	255	254	254	253	251	249	246	245	245	244
Hualien County	356	358	358	359	358	357	356	354	353	352	351
Rilan County	460	464	465	465	466	466	465	465	465	465	464

Source: Council of Labour Affairs, 2004.

The population of Taiwan is concentrated in the North, Central and South regions. In 2003, the areas with populations over one million included Taipei City, Taipei County, Taoyuan County, Taichung City, Taichung County, Changhua County, Kaohsiung City, Kaohsiung County and Tainan County. On the other hand, Taitung County and Chiayi City had only 244 and 269 thousand persons, respectively. Moreover, the population in Taoyuan County had the highest growth rate (26 per cent) over the period 1993-2003. In contrast, the populations in Taipei City, Yunlin County Taitung County and Hualien County declined.

Table 2.6 Employment by region in Taiwan, 1993-2003 ('000s).

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Taiwan	8710	8904	9011	9039	9143	9257	9350	9462	9350	9421	9538
North Region	3414	3513	3605	3638	3696	3764	3839	3919	3889	3920	3971
Taipei City	1110	1133	1151	1127	1107	1113	1125	1137	1110	1116	1119
Keelung City	149	156	156	155	157	159	159	163	162	159	164
Hsinchu City	140	146	146	150	154	154	158	167	162	159	163
Taipei County	1283	1311	1361	1401	1446	1480	1517	1542	1542	1562	1578
Taoyuan County	562	593	612	620	644	668	690	719	726	736	752
Hsinchu County	170	174	179	185	188	190	190	191	187	188	195
Central Region	2213	2286	2300	2296	2332	2367	2378	2398	2372	2365	2383
Taichung City	317	331	342	345	363	380	389	402	402	399	416
Miaoli County	245	245	246	244	241	244	241	241	235	235	233
Taichung Couny	542	575	572	582	605	625	634	644	639	637	644
Changhua County	523	537	538	528	529	532	536	538	538	539	538
Nantou County	227	238	243	239	241	244	238	238	232	226	228
Yunlin County	359	360	359	358	353	342	340	335	326	329	324
South Region	2615	2631	2638	2644	2656	2669	2681	2694	2643	2691	2742
Kaohsiung City	549	555	563	570	567	582	599	603	592	612	631
Chiayi City	105	107	109	106	102	105	105	106	104	102	103
Tainan City	297	310	308	310	314	315	315	318	315	321	331
Chiayi County	270	267	267	261	262	264	255	254	248	247	251
Tainan Couny	505	487	493	490	498	498	493	485	477	492	498
Kaohsiung County	502	521	517	527	536	535	535	547	532	538	550
Pintung County	387	384	381	380	377	370	379	381	375	379	378
East Region	468	474	468	461	459	457	452	451	446	445	442
Taitung County	114	116	115	113	112	110	110	111	109	107	105
Hualien County	157	158	155	147	149	149	146	145	143	145	146
Rilan County	197	200	198	201	198	198	196	195	194	193	191

Source: Council of Labour Affairs, 2004.

Tables 2.6 and 2.7 present the level and growth of employment by region in Taiwan from 1993 to 2003, respectively. The disparate rates of regional population growth were mirrored in their rates of employment growth which suggests that the regions underwent divergent developmental trajectories over this period. For example, Taoyuan County had annual growth rates of population and employment of 2.38 per cent and 3.07 per cent, respectively over this period. By contrast, in Yunlin County population and employment declined 0.14 and 0.89 per cent per year, respectively.

Table 2.7 Employment growth rate by region in Taiwan, 1994-2003 (%)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Taiwan	2.2	1.2	0.3	1.2	1.2	1.0	1.1	-1.1	0.8	1.3
North Region	2.9	2.6	0.9	1.6	1.8	2.0	2.1	-0.8	0.8	1.3
Taipei City	2.1	1.6	-2.1	-1.8	0.5	1.1	1.1	-2.4	0.5	0.3
Keelung City	4.7	0.0	-0.6	1.3	1.3	0.0	2.5	-0.6	-1.9	3.1
Hsinchu City	4.3	0.0	2.7	2.7	0.0	2.6	5.7	-3.0	-1.9	2.5
Taipei County	2.2	3.8	2.9	3.2	2.4	2.5	1.6	0.0	1.3	1.0
Taoyuan County	5.5	3.2	1.3	3.9	3.7	3.3	4.2	1.0	1.4	2.2
Hsinchu County	2.4	2.9	3.4	1.6	1.1	0.0	0.5	-2.1	0.5	3.7
Central Region	3.3	0.6	-0.2	1.6	1.5	0.5	0.8	-1.0	-0.3	0.8
Taichung City	4.4	3.3	0.9	5.2	4.7	2.4	3.3	0.0	-0.7	4.3
Miaoli County	0.0	0.4	-0.8	-1.2	1.2	-1.2	0.0	-2.5	0.0	-0.9
Taichung Couny	6.1	-0.5	1.7	4.0	3.3	1.4	1.6	-0.8	-0.3	1.1
Changhua County	2.7	0.2	-1.9	0.2	0.6	0.8	0.4	0.0	0.2	-0.2
Nantou County	4.8	2.1	-1.6	0.8	1.2	-2.5	0.0	-2.5	-2.6	0.9
Yunlin County	0.3	-0.3	-0.3	-1.4	-3.1	-0.6	-1.5	-2.7	0.9	-1.5
South Region	0.6	0.2	0.1	0.6	0.4	0.4	0.4	-1.8	1.8	1.9
Kaohsiung City	1.1	1.4	1.2	-0.5	2.6	2.9	0.7	-1.8	3.4	3.1
Chiayi City	1.9	1.9	-2.8	-3.8	2.9	0.0	1.0	-1.9	-1.9	1.0
Tainan City	4.4	-0.6	0.6	1.3	0.3	0.0	1.0	-0.9	1.9	3.1
Chiayi County	-1.1	0.0	-2.2	0.4	0.8	-3.4	-0.4	-2.4	-0.4	1.6
Tainan Couny	-3.6	1.2	-0.6	1.6	0.0	-1.0	-1.6	-1.6	3.1	1.2
Kaohsiung County	3.8	-0.8	1.9	1.7	-0.2	0.0	2.2	-2.7	1.1	2.2
Pintung County	-0.8	-0.8	-0.3	-0.8	-1.9	2.4	0.5	-1.6	1.1	-0.3
East Region	1.3	-1.3	-1.5	-0.4	-0.4	-1.1	-0.2	-1.1	-0.2	-0.7
Taitung County	1.8	-0.9	-1.7	-0.9	-1.8	0.0	0.9	-1.8	-1.8	-1.9
Hualien County	0.6	-1.9	-5.2	1.4	0.0	-2.0	-0.7	-1.4	1.4	0.7
Rilan County	1.5	-1.0	1.5	-1.5	0.0	-1.0	-0.5	-0.5	-0.5	-1.0

Source: Council of Labour Affairs, 2004.

Hsu and Cheng (2002) locate the explanation of divergent patterns of development in the distinctive regional accumulation regimes that created diverse regional economies with different industrial structures. For example, semi-conductors dominated in North Region, footwear in Central Region and petrochemicals in South Region. Also government regional policy assumed importance. Hsu and Cheng (2002) argue that the uneven pattern of regional development played an important role in Taiwanese post-war economic growth.

Table 2.8 Employment by sector in Taiwan: 1991 and 2001

	1991 Employment	2001 Employment	Change in job	Percent Change
Total Employment	5855619	6655830	800211	13.7
Mining	17090	8374	-8716	-51.0
Manufacturing	2622934	2418492	-204442	-7.8
Utility	45065	40257	-4808	-10.7
Construction	452176	454846	2670	0.6
Wholesale	1463313	2052164	588851	40.2
Transportation	354780	422168	67388	19.0
Finance	297528	372735	75207	25.3
Industrial Service	156069	280460	124391	79.7
Social Service	446664	606334	159670	35.7

Source: Statistical Year Book of Taiwan, 2007.

Table 2.8 reports employment by sector between 1991 and 2001. Employment in Taiwan increased from 5.86 million to 6.66 million over this period. The Wholesale sector experienced the greatest increase in employment (588,851) followed by Social Services (159,670) and Industrial Service (124,391). In contrast, Manufacturing destroyed the most jobs (204,442), which again demonstrates that the economic base in Taiwan has shifted from the industrial sector to the services sector.

Table 2.9 Sectoral employment by region in Taiwan: 1991 and 2001

	1991 Employment	2001 Employment	Change	Percent Change
North Region				
Total Employment	3033609	3903059	869450	28.7
Mining	4441	948	-3493	-78.7
Manufacturing	1195354	1306103	110749	9.3
Utility	19728	30908	11180	56.7
Construction	223974	218097	-5877	-2.6
Wholesale	863563	1198123	334560	38.7
Transportation	220386	302634	82248	37.3
Finance	168253	324710	156457	93.0
Industrial Service	112532	206859	94327	83.8
Social Service	225378	314677	89299	39.6
Central Region				
Total Employment	1272173	1263414	-8759	-0.7
Mining	6142	4358	-1784	-29.0
Manufacturing	729053	578629	-150424	-20.6
Utility	10109	8007	-2102	-20.8
Construction	81051	93303	12252	15.1
Wholesale	242304	359571	117267	48.4
Transportation	46994	44875	-2119	-4.5
Finance	52062	24190	-27872	-53.5
Industrial Service	18779	33869	15090	80.4
Social Service	85679	116612	30933	36.1
South Region				
Total Employment	1352160	1329369	-22791	-1.7
Mining	2940	1082	-1858	-63.2
Manufacturing	637807	503134	-134673	-21.1
Utility	12826	961	-11865	-92.5
Construction	112759	117020	4261	3.8
Wholesale	309049	434897	125848	40.7
Transportation	74679	65626	-9053	-12.1
Finance	67490	20505	-46985	-69.6
Industrial Service	21796	35736	13940	64.0
Social Service	112814	150408	37594	33.3
East Region				
Total Employment	197677	159988	-37689	-19.1
Mining	3567	1986	-1581	-44.3
Manufacturing	60720	30626	-30094	-49.6
Utility	2402	219	-2183	-90.9
Construction	34392	26426	-7966	-23.2
Wholesale	48397	59573	11176	23.1
Transportation	12721	9033	-3688	-29.0
Finance	9723	3330	-6393	-65.8
Industrial Service	2962	3996	1034	34.9
Social Service	22793	24799	2006	8.8

Source: Statistical Year Book of Taiwan, 2007.

Table 2.9 shows the employment levels by sector across the four regions in 1991 and 2001. Each Region was characterised by a different industrial structure. For example the North Region was concentrated in growing sectors, such as Wholesale, Manufacturing and Finance. By contrast, employment in the other three regions is concentrated in declining sectors, such as Manufacturing and Finance. Moreover, the South Region and East Region were characterised by declining Utility and Construction, respectively.

One special feature revealed in Table 2.9 is that Finance is growing in North Region but is declining in the other three regions. The explanation is that Finance has become highly competitive since the government allowed sixteen private commercial banks to be established in 1991. The financial deregulation not only increased the number of banks, and bank branches, but also permitted domestic banks to conduct stock broking and trading. This tight competition forced local banks to make loans to business, which had inadequate collateral, and thus increased the incidence of overdue loans. The problem of bad debts got worse during the Asian financial crisis in 1997-98. As a result, the banking industry, especially local banks located in the Central, South and East regions, reduced employment. By contrast, banks in the North Region had a low ratio of overdue loans and were largely immune from the financial crisis (Hwa, 2000).

2.4.2 Shift share analysis

Table 2.10 reports the results of the shift share analysis. The national growth share refers to the local employment increase which is attributable to overall employment growth in the economy (Martin, 2003). If each regional economy were identical in structure and performance to the national economy, employment growth in each region would be equal to national employment growth (13.7 per cent).[16] Employment in the North Region, for example, should have increased by 414,564 based on the national growth rate. However, the data from Table 2.9 show that employment in the North Region grew by 869,450. Thus, the North Region performed better than the national trend. The additional employment in the North Region is identified with the other components (industrial mix share and local share) of the shift-share analysis.

The industrial mix share for each sector in the region is an imputed measure of the contribution of the sector at a national level to the change of employment in the region. If there is no employment in sectors which are nationally growing slower than overall employment, then the industrial mix effect is unambiguously positive. By contrast, if a significant level of regional employment was in the growing slowly sectors at a national level, then the industrial mix component would be lower and would ultimately become negative. As shown in Table 2.10, there were positive overall industrial mix effects for the North and East Regions which reflects their specialisation in the relatively fast growing industries, such as Wholesale, Transportation, Finance, Industrial Service and Social Service.

Table 2.10 Shift-Share Analysis across four regions in Taiwan: 1991 and 2001

	Employment change	National growth		Industry mix		Local share	
	Level	Level	Per cent[1]	level	Per cent[1]	level	Per cent[1]
North Region							
Mining	-3493	607	-	-2872	-	-1228	-
Manufacturing	110749	163353	147	-256524	-232	203920	184
Utility	11180	2696	24	-4801	-43	13285	119
Construction	-5877	30608	-	-29285	-	-7200	-
Wholesale	334560	118012	35	229494	69	-12946	-4
Transportation	82248	30117	37	11744	14	40387	49
Finance	156457	22993	15	19537	12	113927	73
Industrial Service	94327	15378	16	74313	79	4636	5
Social Service	89299	30799	34	49767	56	8733	10
Total	869450	414564	48	91372	10	363514	42
Central Region							
Mining	-1785	839	-	-3972	-	1348	-
Manufacturing	-150424	99630	-	-156455	-	-93599	-
Utility	-2102	1381	-	-2460	-	-1023	-
Construction	12251	11076	90	-10598	-87	11773	96
Wholesale	117268	33113	28	64393	55	19762	17
Transportation	-2119	6422	-	2504	-	-11045	-
Finance	-27872	7115	-	6045	-	-41032	-
Industrial Service	15090	2566	17	12401	82	123	1
Social Service	30933	11709	38	18919	61	305	1
Total	-8759	173851	-	-69222	-	-113388	-
South Region							
Mining	-1858	402	-	-1901	-	-359	-
Manufacturing	-134673	87161	-	-136874	-	-84960	-
Utility	-11865	1753	-	-3121	-	-10497	-
Construction	4261	15409	362	-14743	-346	3595	84
Wholesale	125849	42234	34	82131	65	1484	1
Transportation	-9054	10205	-	3979	-	-23238	-
Finance	-46985	9223	-	7837	-	-64045	-
Industrial Service	13940	2979	21	14393	103	-3432	-25
Social Service	37594	15417	41	24911	66	-2734	-7
Total	-22791	184782	-	-23389	-	-184184	-
East Region							
Mining	-1582	487	-	-2307	-	238	-
Manufacturing	-30094	8298	-	-13031	-	-25361	-
Utility	-2184	328	-	-585	-	-1927	-
Construction	-7966	4700	-	-4497	-	-8169	-
Wholesale	11177	6614	59	12862	115	-8299	-74
Transportation	-3688	1738	-	678	-	-6104	-
Finance	-6393	1329	-	1129	-	-8851	-
Industrial Service	1034	405	39	1956	189	-1327	-128
Social Service	2006	3115	155	5033	251	-6142	-306
Total	-37689	27014	-	1239	-	-65942	

Notes: [1] Percentages are reported when overall employment change is positive.

The final component of the shift-share analysis is called the local share. It is the employment change that is left over after accounting for the national and industrial mix components. If the local sectors are actually growing faster than the corresponding sectors are growing nationally then the local effect will be positive. For example, the local share effect for the North Region represents 363,514 jobs. This positive local effect indicates that the North Region had a competitive advantage in Manufacturing and Finance over the sample period.

The North Region outperformed the national economy with positive industrial mix effects and local effects (see Table 2.10). Specifically, 48 per cent of the positive employment growth in North Region can be attributed to the national growth component, 10 per cent to the industrial mix component and 42 per cent to the local effect component. In contrast, both Central and South Regions are characterised by negative industrial mix and local effects. Moreover, East Region has a positive industrial mix share and negative local share. It should be noted that the separate sums of the industrial mix share effects and local share effects across the regions are zero.

The explanation for industrial mix and local effects across the four regions is that the regions have distinctive economies which had their own unique trajectories. The North Region, which consists of the Taipei metropolitan area, has grown faster than other regions of Taiwan in past several decades, and, thus, has become the core area of Taiwan. The North Region has the smallest area (about 20 per cent of Taiwan)[17] but 41 per cent of the population lived there in 1999. Moreover, North Region has an integrated transportation network, which includes the railway system (Taiwan High

Speed Rail and Taipei Rapid Transit System), airports (Taoyuan International Airport and Taipei domestic Airport) and ports (Taipei Port and Keelung Port).

Another influence on the competitive advantage of the North Region is that the industrial areas of Taipei, Taoyuan and Hsinchu, which represent 47 per cent of Taiwan's factories, are located in the North Region (Directorate-General of Budget, Accounting and Statistics, 2003). In particular, rapidly growing high-technology industries are clustered in the Hsinchu industrial area[18] and are major contributors to the growth of the North Region. Anas *et al.* (1998) explain that spatial agglomeration can occur because similar firms locate close to each other in order to reduce lower per unit costs. In particular the presence of a spatial heterogeneous resource, internal scale economies in production, external scale economies and imperfect competition can lead to agglomeration. A spatial heterogeneous resource, such as soil, climate, mineral deposits and access to waterways, can be the source of regional comparative advantage. Internal scale economies refer to lower per unit costs associated with the increased level of production of public or private goods. External scale economies refer to contact externalities between firms and market linkages. For example, a firm could be located in close proximity to its market in order to reduce transport cost.

During the 1970s and 1980s, light industry, including footwear, was located in the Central Region. This region was referred to as the "shoe nest" because 80 per cent of Taiwan's footwear manufacturers were located there, especially in the townships around its largest city, Taichung City. The Taiwanese were the world's largest footwear exporters in the 1970s and 1980s (Hus and Cheng, 2002). Since liberalisation commenced in the late 1980s, the abrupt appreciation[19] of the Taiwanese currency against the US dollar directly hit the footwear industry. The number of registered enterprises reached its peak of about 1245 in 1988 and then fell to 627 enterprises by 1994. Since then Construction and Services have become the dominant industries in Central Region. By 2001, the centre of the Central Region, Taichung City, had evolved to become a unique regional economy with the dominance of Services firms, because 82 per cent of enterprises in Taichung City are classified in Services.

After the Japanese colonial period (1896-1945), the Centre of South Taiwan, Kaohsiung City became the centre for heavy industry. Since the first naphtha cracker plant was constructed in 1968, heavy industry (such as petrochemicals, shipbuilding industry and steel) continued to be located in the South Region. The development of heavy industry in Kaohsiung City played a major role in the shift of the Taiwanese industrial structure from light industry to heavy industry during the 1970s and 1980s. After the mid-1980s, the development of heavy industry faced waves of labour and environmental protests because years of air and water pollution had caused serious health problem to the people living in the Kaohsiung City as well as other areas in South Region. The emergence of the environmental movement and cheap labour in other late industrialising countries hastened the decline of heavy industry and led to the establishment of Southern Taiwan’s Science Park (STSP) in South Region. The Science Park, which includes the Tainan Science Park and Kaohsiung Science Park, was approved in 2001 and employed 47371 workers in 2006 (Statistical Year Book of Taiwan, 2007). Thus, the South Region was transformed from a reliance on heavy industry to an increased role for high-tech industry (Jiang and Liu, 2005).

The East Region also evolved into a distinctive regional economy. Compared to the other three regions, East Region is relatively small and mountainous with only 15 per cent of the ground being level, which, with its geographical isolation, limits opportunities for industrial development. Agriculture was the main industry but Tourism is now leading the development of the East Region and is being promoted by both central and local governments (Kuo, 2005).

In summary, we conclude that there has been a wide range of factors, including government policy, the dynamics of industry specialisation and geography which have contributed to the distinct patterns of industrial development across the regions. In particular, government regional policy has influenced the location of heavy industry in South Region and the promotion of the Tourism industry in East Region. On the other hand, high-tech industry became established in North Region, light industry in the Central Region, heavy industry in the South Region and Tourism in the East Region and these industries have exploited the economics of agglomeration. The development of the East Region has been affected both by its terrain and its relative isolation.

Although shift-share analysis is able to identify regional advantage and potential growth sectors, it is based on two particular points in times and unable to describe the process of employment growth over the business cycles. Thus, analysis of the processes of job creation and destruction over business cycle at the regional level would enable a better understanding of the dynamics of regional unemployment (see Chapter 8).

2.5 Labour market policy in recession

The unemployment insurance law was implemented in 1999 and paid 38.7 billion NT dollars (around 1.4 billion AU dollars[20]) in 2006. The purpose of the law was to provide financial support for workers during a period of unemployment[21]. An insured person who has involuntarily left work and meets some essential conditions[22] is eligible to claim unemployment benefit, which includes an unemployment subsidy, vocational training subsidy and national health insurance premium support. Due to the recession in 2001, the payment of unemployment insurance rose from 516 million NT dollars in 1999 to 10,240 million NT dollars in 2002 (see Table 2.11). However, in 2003, the number of recipients and total payments of unemployment insurance decreased because of the implementation of the Public Service Employment Program.

Table 2.11 Recipients and unemployment insurance outlays (1999-2006)

	1999	2000	2001	2002	2003	2004	2005	2006
Recipients	11,341	24,018	114,859	103,260	64,537	46,154	57,487	63,494
Outlays ($NT000s)	516,371	166,519	7,825,440	10,204,120	5,458,734	3,680,158	4,406,324	4,957,930

Source: Council of Labour Affairs, 2007

Between December 2000 and March 2002 Taiwan economy endured a recession. The pool of unemployment grew from 293 thousand in 2000 to 515 thousand in 2002. In addition, the Taiwanese unemployment rate rose to 5.17 per cent in 2002 – which was the highest rate since data had been collected.

In order to solve this problem, Taiwanese government followed the Korean initiative and announced the creation of employment opportunities through the expansion of public services. Over 1997-98, Korea had faced the Asian financial crisis and suffered negative economic growth of 6.7 per cent. The unemployment rate increased from 2.6 to 6.8 per cent. The Korean government provided short-term job opportunities for unemployed people, through public service projects, which maintained a stable social environment. Between 1998 and 2002, the Korean government spent 170 billion NT dollars and generated a total of 3.87 million jobs for unemployed people. As a result, the unemployment rate declined from 6.8 per cent in 1997 to 5.3 per cent in 1999 and 2.7 per cent in November 2002. The successful experience in Korea led the Taiwan government to implement a Public Service Employment Program between January 2003 and June 2004 (The Directorate General of Budget, Accounting and Statistics, 2005).

The purpose of the Public Service Employment Program was to help disadvantaged workers, such as middle/senior aged, aborigine, or handicapped, to secure jobs. The Council for Economic Planning and Development (CEPD) invited all mayors to attend a meeting to discuss the public service jobs initiative. The mayors provided data on the incidence of unemployment of their county/city residents (above 35 years old) as well as public service employment opportunities. The monthly salary for the public service jobs ranged from 20,000 to 22,000 NT dollars. These jobs included public information services and database collection, agriculture surveys, public facilities maintenance and inspection, care services for the elderly, community services, public security administration, environmental beatification and resource recycling. The Council for Economic Planning and Development (CEPD) estimated that the program would create 75,000 jobs and lead to a decline of the unemployment rate in 2003 of 0.23 percentage points. In order to avoid aggravating the unemployment problem after the termination of the Program at the end of 2004, CEPD implemented a follow-up Public Service Employment Program in the second half of 2004, which had offered 43,548 job opportunities by December 2004. CEPD estimated that the second program would lead to a decrease of about 0.11 percentage points in the unemployment rate in 2004.

Based on recruitment and the registered public work jobseekers statistics, 72,699 registered public work jobseekers were employed on December 2003. Males represented 53.65 per cent of this group and females 46.35 per cent. Around 67 per cent of them were middle aged or older, that is between 45 and 64. Senior (vocational) high school graduates took up 33.71 per cent of the jobs and primary school graduates obtained 31.57 per cent of the jobs.

In order to assess the outcomes of the Public Service Employment Program, CEPD also launched a survey of employees' attitudes towards the Program. About 55 per cent of the 997 employees who were interviewed claimed to be the principal family bread winner, and a further 36 per cent indicated that they also had to contribute to family income. About 81 per cent of those interviewed agreed that their participation in the Public Service Employment Program had improved their relationships with fellow family members, and 84 per cent agreed to the statement that participation in the Public Service Employment Program made them feel more self-confident. Thus the Public Service Employment Program had a significant effect on family welfare and also contributed to employees' psychological welfare.

Under the Public Service Employment Program, the Executive Yuan’s Council of Labour Affairs (CLA) supported a range of related vocational training programs with the goal of improving employees’ job skills and helping the unemployed to return to the private labour market. For example, around 70 per cent of the employees who joined the Public Service Employment Program did not know how to use a computer. The Bureau of Employment and Vocational Training (BEVT) proposed a 36-hour basic PC skills program for 10,000 applicants. BEVT also integrated vocational training into the educational system and offered training in areas such as care services and environmental ranger training. Moreover, BEVT provided on-line education in restaurant management, information technology and software, and micro entrepreneurial skills. Among the employees interviewed, however, only 56 per cent agreed that they could “learn” working skills by taking a public work job, which indicated that the Public Service Employment Program did not contribute significantly to the development of job skills. This evidence suggests that CLA should not only provide vocational training relevant to public service employment but also professional educational programs which are aligned to the needs of employers.

Under the Protection Law for the Handicapped and Disabled, each Taiwanese resident with a disability must go to a designated hospital for examination to establish the status of her/his disabilities. The Bureau of Social Welfare would then issue a handicap certificate for related benefits. These benefits include a disability allowance[23], a subsidy for medical equipment, an insurance premium subsidy[24], sign language services, a rent subsidy and vocational training. The protection law, which has operated since 1990, also requires that all private firms with more than 100 employees hire at least one disabled worker. 2 per cent of employees must be disabled in

Government offices, public schools, and public enterprises with 50 or more employees. The Public Service Employment Program also considered disabled jobseekers as a priority and employed around 5,087 disabled employees.

The Public Service Employment Program survey also showed that employees tended to rely upon the government's employment scheme. About 92 per cent of those interviewed said that they would wish to continue taking temporary public sector jobs if possible. The possible explanation is that either it is difficult for those interviewers to find permanent employment and/or they prefer public sector to private sector jobs.

The Taiwanese government also implemented a Small and Medium Enterprises (SMEs) Manpower Project. In terms of employment, Taiwanese Small and Medium Enterprises Administration (SMEA, 2007) define SMEs as those firms that have less than 200 employees in manufacturing and construction sectors, and less than 50 employees in the service sector. The conventional wisdom, as reflected in speeches by politicians and statements from the Taiwan's Small and Medium Enterprises Administration (SMEA), was that small and medium enterprises (SMEs) were the engine of employment growth and economic growth[25]. We address this issue in detail in Chapters 3 and 4. An employment subsidy of 10,000 NT dollars per month per worker was provided to private SMEs, when they employed a new worker. The NT$ 3.3 billion budget of the SMEs Manpower Project was designed to help the SMEs to hire 25,000 unemployment people. During this period, applications from 13,543 enterprises were filed and 58,994 new employees were subsidised. On the expiration of the subsidisation period, most employees left their positions and there were only 5,597 subsidised employees still in employment (The Directorate General of Budget, Accounting and Statistics, 2005).

The high worker separation rate (91 per cent) suggests that the wage subsidy scheme was unsuccessful, with the likely explanation being that employers chose not to maintain these jobs, once the subsidies ceased. The high worker separation rate based on the SMEs Manpower Project also provides some support for the view that the high unemployment rate during the recession was a structural problem rather than one a demand deficiency (Lee, 2004).

The shift of the economic base from the industrial sector to the services sector (See Figure 2.4 and Figure 2.5) is a contributory factor. There is evidence of growing unemployment of workers displaced from the declining sectors (for example, manufacturing and construction) and rising unfilled vacancies in the growing (services) sector, which indicates that the displaced workers do not have the skills to take up the opportunities in the services sectors, such as tourism and property management (The Directorate-General of Budget, Accounting and Statistics, 2004). Certainly this particular episode in Taiwan does not support the claim that SMEs have greater employment creating powers. The academic literature does not have a consistent view on this issue (see Chapter 3).

2.6 Conclusion

In this Chapter, we have discussed the basic features of the overall post-war Taiwanese economy. Significant structural change has occurred with the rise in the shares of output and employment in services, and declines in the industrial sector. Moreover, using shift-share analysis we have found that there have been divergent development trajectories across regions with respect to employment. The evolving pattern of industrial specialisation, which has reflected competitiveness and forces of agglomeration, has been complemented by government regional policy, to shape the distinctive patterns of economic growth across the four regional economies. In addition, the geography of the country has been influential both with respect to access to markets and the availability of usable land.

However, the changing patterns of sectoral employment hide interesting and crucial information about the labour market, namely the gross number of jobs created and destroyed at both the aggregate and regional levels. For example, a net employment increase of 5,000 may mean 5,000 hires and no job separation, or it may mean 50,000 hires and 45,000 separations. The first scenario represents a less flexible labour market, while the second describes a relatively dynamic labour market with the possibility of improved matching given the massive reallocation of labour relative to the net inflow into employment. Thus, the investigation of job creation and destruction by sector and region would contribute to a greater understanding of the dynamics of employment.

We also found that large flows of workers enter and exit the employment pool. The large worker flows offer an interesting parallel to the job flow dynamics. When a firm closes an establishment and destroys jobs, workers are forced to enter the unemployment pool or leave the labour force. When a firm creates jobs, workers may move from other firms or from the unemployment pool or from not in the labour force status to fill the positions. However, a component of the worker flow out of employment results from voluntary resignation. Thus, the relationship between worker and job flows merits further investigation.

We have also discussed the operation of the Public Service Employment Program and the Small and Medium Enterprises (SMEs) Manpower Project. Although the living conditions[26] of the unemployed improved due to the Public Service Employment Program, the wage subsidy scheme for SMEs was unsatisfactory because of the high separation rate, so that the increase in employment arising from the program was not sustained. The thesis will investigate the hypothesis that small business outperforms large business with respect to job creation (and destruction) in Taiwan.

This thesis has four objectives. First, the SME job creation hypothesis is examined (Chapter 3 and 4). We are interested in how job creation and destruction behaviour and net employment change are related to plant size in Taiwanese manufacturing, service, and construction sectors during the period 1987 to 2003. Second, we investigate the feature of job reallocation and its relationship with worker turnover in Taiwan (Chapter 6). Third, we explore the cyclical behaviour of job creation and destruction over the business cycle (Chapter 7). Fourth, we investigate the similarities and differences of business cycle characteristics in the four core regions in Taiwan in terms of net employment change, as well as job creation and destruction (Chapter 8). This analysis provides some interesting empirical results, which yield insights into the operation of the Taiwanese labour market and have implications for policymaking.

Appendix: Shift Share Analysis

Shift-Share analysis which was developed by Fuchs (1962) and Ash (1968), provides a useful way of representing growth patterns and hence the competitiveness of sectors across regions of the economy. The Shift-Share method decomposes employment change (ΔE_{ij}) in a region over a given time period into three components: i) a component that is attributable to growth of the national economy (S_{ij}); ii) a mix component (T_{ij}) which reflects unequal national sectoral rates of growth; and iii) a local component reflecting the competitiveness of the local sectors (R_{ij}). Then

(2.1A) $\Delta E_{ij} \equiv S_{ij} + T_{ij} + R_{ij}$

where i denotes sector and j denotes region.

The national growth component (S_{ij}) is obtained by multiplying the base year employment (E_{ij}) for each sector by the national average employment growth rate ($\frac{\Delta E_{00}}{E_{00}}$) over the time period.

(2.2A) $S_{ij} = E_{ij} \times \frac{\Delta E_{00}}{E_{00}}$

The industry mix effect (T_{ij}) picks up the impact on sectoral employment in each region which arises from the national variation in sectoral growth rates. This component is found by multiplying base year regional employment in each sector by the difference between the national sectoral growth rate and the overall national growth rate.

(2.3A) $T_{ij} = E_{ij} \times (\frac{\Delta E_{i0}}{E_{i0}} - \frac{\Delta E_{00}}{E_{00}})$

The local share effect (R_{ij}) measures how firms in the region have performed relative to the national averages for firms in those sectors. A positive local share component suggests regional businesses are growing faster than those sectors at the national level. To calculate the local share effect, base year employment in each local sector is multiplied by the difference between the sectoral growth rate by region and the average national growth rate for that sector.

(2.4A) $$R_{ij} = E_{ij}\left(\frac{\Delta E_{ij}}{E_{ij}} - \frac{\Delta E_{j0}}{E_{j0}}\right)$$

It can readily be established that (2.1A) is satisfied as an identity.

Notes:

[1] The total area of Australia is about 7,686,850 sq km. Even the area of the smallest state (Tasmania) is around 67,800 sq. km which is about double Taiwan's area (http://www.planetware.com/australia/tasmania-aus-tas-tas.htm). The area of Taiwan is similar to The Netherlands whose area is about 37,330 sq km (http://members.chello.nl/j.kersten21/start.htm).

[2] For example, labour laws and regulations that were inconsistent with service sector development were revised, such as those that impeded the engagement of part-time employees and the recruitment of foreign labour.

[3] The growth rate collapsed in 1974 and 1975 because of the oil shock.

[4] The population increased from 8.85 million in 1952 to 23.04 million in 2006.

[5] On 15 July, 1987, President Chiang, Jin-kuo announced the end of martial law to enhance constitutional democracy and foster the healthy development of cross-strait relations. Meanwhile, The Central Bank of Taiwan (CBT) promoted economic liberalisation and relaxed restrictions on trade and financial markets, which included foreign exchange management reform, and the liberalisation of capital flows (Wen, 1997).

[6] The periods of expansion and contraction are based on the business cycle dates provided by the official agency - the Taiwanese Council for Economic Planning and Development (CEPD).

[7] A recession is defined as a decline in GDP that lasts for two or more quarters (Mitchell, 2001). The quarterly economic growth rates in 2001 were 0.61, -3.12, -4.63 and -1.48, respectively.

[8] The service sector has played an increasingly important role in the domestic industrial structure. In 2000, the service contributed 65.5 per cent of GDP, while the industry

sector and agriculture sector had 32.4 per cent and 2.1 per cent of GDP, respectively. Structural shifts are further discussed in Figures 2.4 and 2.5.

[9] The Chinese communists posed a very real and immediate military threat to national security throughout the 1950s and 1960s. The Battle of Quemoy at Kuningtou in 1949, the Battle of Tachen Islands from 1954 to 1955, and the Battle of the Taiwan Strait on August 23, 1958, were each fierce battles between the ROC and communist forces. Although there were some sporadic skirmishes and minor sea battles after the Battle of the Taiwan Strait, political tensions between the two sides gradually eased and the frequency of direct military clashes slowly subsided after 1965 (Wen, 1997).

[10] The unemployment rate was 2.4 per cent in 1975 due to the effect of the first oil crisis.

[11] For example, the Bureau of Foreign Trade reported that from January to September 2006, bilateral trade between Taiwan and China reached US$64.44 billion which accounted for 20.4 per cent of Taiwan's total foreign trade, and represented a 16.9 per cent growth compared with the same period in the previous year.

[12] Taiwan and Mainland China enjoy the same language and culture, and Taiwan lies just 180 kms from the coast of the mainland.
(http://en.wikipedia.org/wiki/Taiwan_Strait).

[13] The industry sector is defined as economic activity that involves the processing of raw materials and their use in the manufacture of goods (Taiwan Statistical Data Book, 2007).

[14] Recently, Liu (2008) explored the factors affecting labour participation status, by using data collected by government's manpower survey in 2006. Using a logistic regression analysis, Liu (2008) finds that the labour force participation rate is significantly affected by age, education level and children's age.

[15] Other house issues include caring for elders, moving house and family conflict (Directorate General of Budget, Accounting and Statistics, 2007).

[16] As pointed out by Cunningham (1969) and Thirlwall (1969), the components to the national economy and regional growth can be correlated. According to Thirlwall's formulation, the correlation (ρ) between regional and national employment growth is -0.0148 for the North Region, -0.0107 (Central Region), -0.0087 (South Region) and 0.1042 (East Region). These values indicate that the correlations between regional and national employment growth are low.

[17] The area of the North Region is about 7,353 square kilometres, whereas the Central Region is 10,506 square kilometres Region, the South Region is 10,002 square kilometres and the East Region is 8,143 square kilometres.

[18] The Hsinchu Science-based Industrial Park (HSIP) was established in December 1980 to introduce high-tech industries and attract talent to Taiwan, to promote the upgrading of Taiwanese industries, to balance regional development and to drive national economic development. Since the HSP was established, the government has invested US$1,679 million on park infrastructure and facilities. A total of 384 high-tech establishments had been established in the park by the end of 2004.

[19] The exchange rate appreciated from 35 (NT$ per AU$) in 1987 to 25 (NT$ per AU$) in 1989 (Statistical Year Book of Taiwan, 2007).

[20] The AU$/NT$ exchange rate was about 28 (NT$ per AU$) in January 2008 (The Directorate General of Budget, Accounting and Statistics, January 2008).

[21] Unemployment insurance is paid for a maximum of 6 months at 60 per cent of the applicant's average monthly salary.

[22] These conditions include that (1) the applicant has accumulated a total of at least one full year in the insurance program during the previous three years; and (2) the applicant

has registered at a public employment service institution to seek employment but has not been offered a job or vocational training within 14 days of registration.

[23] The allowance ranges from NT$1,000 to $6,000 based on the category and level of disability and the age of the disabled person.

[24] The Bureau of Social Welfare subsidises (25 per cent to 100 per cent) of the health insurance fees for a registered resident with a disability certificate.

[25] Small and Medium Enterprises (SMEs) have contributed greatly to tax revenue, job creation, technology innovation, and production value (Lin *et al.,* China Times, January 17 2003)

During the last decade, Small and Medium Enterprises (SMEs) have been the foundation stone of economic growth and created a large number of new jobs in Taiwan (SMEs White Paper, 2007).

[26] The point here is that some of the unemployed were able to secure jobs under the Public Service Employment Program which improved both their financial and psychological welfare.

Chapter 3 Data and Measures

3.1 Introduction

The aim of this Chapter is to introduce the data and to outline the construction of the measures employed throughout the thesis. In Section 3.2 we describe the data and their characteristics. The thesis employs a unique monthly dataset, which reduces the so-called netting-out problem common to studies that use quarterly or annual data. This dataset allows us to explore the time-series behaviour of job creation and destruction within years and across years. The quality of the data is such that we are also able to examine the dynamics of job creation and destruction in terms of plant size and industry sectors at both the national and regional levels.

In Section 3.3 we introduce the definitions of job reallocation and worker turnover. In Section 3.4 we define two measures of job dynamics: (a) base-size measures; and (b) current-size measures. These different measures are central to the methodological debate underpinning the small business job creation hypothesis, namely that small business outperforms large business with respect to job creation (and destruction). Small and large businesses must be defined by their levels of employment, and rules are required to assign employment changes to small and/or large business. In this thesis, our chosen classes coincide with those used by Davis *et al.* (1996a; 1996b) and Davidsson *et al.* (1998). In Section 3.5 the adjusted base-size measure is introduced. This measure enables the correct assignment of employment change to the size classes and hence overcomes regression bias which is associated with the base-size measure. Section 3.6 provides a summary of the main results derived in this Chapter.

3.2 Data Description

The data are drawn from the Survey on Earnings of Employees (SEE) from 1987 to 2003[1] conducted by the Statistical Bureau of Taiwan. The data are collected monthly at the establishment level. The areas surveyed by the SSE include 15 counties (Taipei, Taoyuan, Hsinchu, Taichung, Miaoli, Changhua, Nantou, Yunlin, Kaohsiung, Tainan, Chiayi, Pingtung, Rilan, Hualien and Taitung) and two metropolitan areas (Taipei City, Kaohsiung City). Based on the Standard Industrial Classification system of the Republic of China (SIC of RoC) provided by the Directorate General of Accounting, Budget, and Statistics, the data cover the Manufacturing, Mining, Utility, Construction, Wholesale, Transportation, Finance, Industrial Service and Social Service sectors (see Appendix). The establishments surveyed encompass both public and private employers, but exclude plants belonging to the Ministry of Defence and Prisons.

There are three main sections in the SEE. First, total employment is broken down into full-time and part-time workers. The data also include the number of entries and exits by employees. All employees are classified by sex and working characteristics (technical and non-technical). Second, total working hours are broken down into normal and overtime. Third, employee wages include the payment for normal working hours, overtime and the festival day. The questionnaire also includes auxiliary questions such as the number of employees last month, the frequency of holidays and the payment of any casual bonuses.

Since the data are collected monthly, the conduct of the survey is broken down into separable components and the responsibility spread across various government ministries. The following table details the sectors surveyed and the responsible government ministry.

Table 3.1 Survey on Earnings of Employees by Sector and Responsible Ministry

Industry sector	Responsible Ministry
Manufacturing, Utility and Wholesale	Ministry of Economics
Mining, Social Services and Personal Services	Bureau of Statistics
Transport	Ministry of Transportation
Construction	Ministry of the Interior
Finance and Industrial Services	Ministry of Finance

Source: Directorate General of Accounting, Budget, and Statistics, Taiwan, 2006.

The survey is conducted between the first and twentieth day of each month and asks for information from the previous month. Once the data is collected, the Bureau of Statistics is responsible for the assessment and statistical analysis of the data. The survey method varies across sectors. Face to face interviews are conducted in Construction, Mining, Wholesale, Industrial Services and Social Services. A postal questionnaire is used in Manufacturing, Utilities, Transportation and Finance. The quality of responses for the questionnaire has improved significantly since the introduction of an Internet-based survey instrument in September 1999. Increasing numbers of employers have participated in the SEE since the introduction of the Internet-based questionnaire.

Both census and stratified random sampling are used in the SEE, with the choice between the two depending on the sector being surveyed. The Utilities, Mining, Public Transportation and Finance sectors are surveyed by census. Stratified random sampling is used in Manufacturing, Construction, Wholesale, Private Transportation, Industrial Services and Social Services. The stratified random sampling methodology is based on the Industry Commerce and Service Census (ICSC) which is run every five years. However, the stratified random sampling is adjusted by information contained in business tax files provided by the Ministry of Finance. Stratified random sampling is also based on the number of employees. The determination of strata boundaries is based on a generalisation of the classical approach of Dalenius and Hodges (1959). Accordingly, for a fixed sample size and a fixed number of strata, the strata boundaries are determined by a method that approximately minimises coefficients of variation. The sample distribution across strata is decided by Neyman optimal allocation.

There are six major advantages of these data compared to datasets previously employed by researchers investigating job dynamics. First, the monthly frequency provides significant advantages over lower frequency data. For example, say a plant dismisses 100 employees in January 1998 and hires 70 employees in July 1998. Using annual data would show a net job loss of 30 employees in 1998, whereas monthly data provides a more complete representation of the relevant job flows. Second, the SEE data allows us to capture the effects of job shifts within plants. For example, assume that a plant replaces some technicians with the same number of software programmers which means there is no net employment change over the month. The SEE data overcomes this limitation by providing information on both the entry and exit of workers in each classification. Third, job creation and destruction data are available for the service sector which has been subject to minimal analysis in past studies. Typically, the manufacturing sector is analysed and the results are assumed to apply to other sectors. However, Ritter (1994) finds that the US services sector displays employment dynamics that are quite different to those found in the manufacturing sector. Fourth, the SEE has been conducted since 1987 which allows the investigation of the cyclical behaviour of job creation and destruction in that the dataset spans three distinct business cycles. Fifth, the SEE dataset permits the allocation of the exact number of jobs to the old (size) class and new (size) class(es) for inter-class plants (that is, those plants which move between employment classes between sample observations). Finally, the SEE dataset enables us to identify actual employment in each plant over 2 consecutive months, but a time series of employment for each plant is not available.

Despite the advantages outlined above, the SEE data are subject to some limitations. First, the plant data may include employees who move across plants within the same firm, which means that rates of job creation and destruction may be overestimated if we are concerned with the employment dynamics of firms. Nevertheless, Hamermesh *et al.* (1996) suggest that inter-plant transfers are a minute fraction of worker flows, which would suggest that this weakness would not unduly influence the main findings of this study. In order to treat this issue with caution, the influence of inter-plant movements is discussed in Chapter 4 and the main components of worker exit and entry are explored in Chapter 5. Second, the data do not reveal the contribution of the entry and exit of plants to job flows, that is the so-called birth and death effects, because data on new plants or exiting plants are not available.

Third, Picot *et al.* (1994) point out that employment change associated with inter-class plants consists of two components: a long run and a transitory component. Many of these employment changes are transitory with temporary increases (or decreases) being reversed in the short run[2]. Unfortunately, the SEE dataset is unable to track individual plants over time[3], so the present study cannot explore the employment dynamics of inter-class plants based on long run trend and transitory components[4].

3.3 The definition of job reallocation and worker turnover

We employ the measures of gross job flows originally proposed by Davis and Haltiwanger (1992) in the analysis of employment dynamics in this thesis. The net employment change in plant *i* from period *t*-1 to *t* is

(3.1) $$\Delta E_i = E_{it} - E_{i,t-1}$$

Gross job creation (JC) is defined as the sum of the positive net changes in employment across the relevant plants while gross job destruction (JD) is the sum of the absolute values of the negative net changes across the other plants.

(3.2) $$JC = \sum_i \Delta E_i^+$$

(3.3) $$JD = \sum_i \left|\Delta E_i^-\right|$$

The aggregate net change in employment (NET) is the difference between gross job creation and destruction:

(3.4) $NET = JC - JD$

The sum of job creation and destruction is termed job reallocation (JR), which describes the reshuffling of employment opportunities across establishments.

(3.5) $JR = JC + JD$

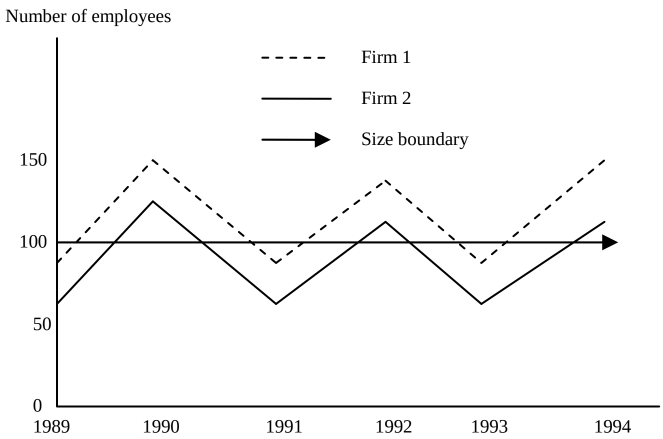
Entries by employees are divided into hiring, recall, coming from other plants and employees who have finished military service and have come back to work. Exits by employees are divided into quits, layoffs and other exits[5]. Employee turnover (T) is denoted as the sum of the worker entries and exits. Job reallocation counts jobs, while worker turnover counts individuals. Job reallocation is calculated by taking first differences of employments stocks, while worker turnover records all worker entries and exits in a given time period. In other words, worker turnover can be divided into two components: turnover due to the creation and destruction of positions as plants expand or contract (job reallocation) and turnover due to workers commencing or leaving continuing positions (Tsou *et al.*, 2001).

For example, consider an economy with two plants for simplicity. Plant A lays off 10 workers in July 1999 and hires 25 workers in September 1999; hence, if we treat the data as quarterly Plant A creates 15 jobs over the three month period. Meanwhile, Plant B hires 6 workers in July 1999 and 13 workers are laid off in September 1999; hence, Plant B destroys 7 jobs in the three month period. Thus, job reallocation is 22 (15 jobs created by Plant A + 7 jobs destroyed by Plant B) as total job change, while worker turnover is recorded as 54 (35 workers in Plant A + 19 workers in Plant B) since 54 workers change positions in these two plants over the period July 1999 to September 1999. The share of worker turnover caused by job reallocation, which can be interpreted as 'involuntary worker turnover' is 100*22/54=40 per cent. In this example, the low proportion of 'involuntary worker turnover' suggests the labour market is more dynamic because job-match creation and destruction, attributable to firm-initiated turnover across continuing positions, is responsible for the larger fraction (Tsou *et al.*, 2002).

3.4 Methodological debate

The job creation hypothesis is based on the proposition that small business outperforms large business with respect to job creation (and destruction).[6] An empirical investigation of the job creation hypothesis requires the assignment of employment change arising from job creation and destruction to arbitrarily defined size classes. In the literature two types of assignment have emerged, namely the base-size measure (Birch, 1979) and the current-size measure (Davis and Haltiwanger, 1992). The base-size measure credits each firm's employment change between periods t-1 and t to the size class at period t-1; while the current-size measure credits the firm's employment change to the size class associated with employment averaged over periods t-1 and t. The importance of the distinction is highlighted by the problem of regression bias or 'regression-to-the-mean bias'. This bias arises because firms or plants temporarily grow or contract across size boundaries. If the 'base-size' measure of job dynamics is used, these employment changes bias the estimates of job creation and destruction in favour of small business.

Figure 3.1 Inter-class movement and regression bias



Source: Davidsson *et al.*, 1998, p.89.

Figure 3.1 is based on Davidsson *et al.* (1998, p. 89) and depicts the concept of regression bias using annual data. Defining small business as firms with less than 100 employees, we would classify firms 1 and 2 as being ‘small’ in 1989. In 1990, using this benchmark both firms become ‘large firms’. By employing the base-year (1989) classification of the firms, the job creation of these growing firms over this period will be attributed to small business. In 1991, both firms fall back into the small size category. Consequently, the job destruction generated by the firms will be assigned to the large business category. Clearly, this way of accounting for job gains and losses is a source of bias if there are inter-class movements.

The regression fallacy (Galton’s Fallacy[7]) is the most common fallacy in statistical analysis (Friedman, 1992), yet it is often ignored by researchers (Davidsson *et al.*, 1998). Secrist (1933) suggests that enterprises tend toward their average size over time. However, Hotelling (1933, p.464) points out that Secrist’s evidence suffers from regression bias. Sixty years or so later, Friedman (1992), Quah (1993), Bliss (1999), Cannon and Duck (2000) focus on regression bias by exploring whether per capita income levels converge across countries.

Friedman (1992) first points out that the small business job creation hypothesis might involve regression bias. Friedman (1992, p. 2131) states that ‘everyone knows that job creation comes mainly from small firms. That proposition may be true but the evidence offered for it that I have seen classifies firms by size in an initial year and traces subsequent levels of employment. … I have yet to see the data show if the firms are classified by their terminal size, or by their average size over a period.’

As noted above, the base-size and current-size measures employ different denominators to measure job and worker flows as rates of change. The current-size measure divides job and worker flows by the simple average of employment in periods *t*-1 and *t*, whereas the base-size measure divides job and worker flows by employment in period *t*-1.

For example, assume Plant A with 16 employees, creates 6 jobs in one year. Using the base-year measure, the job creation rate would be 100*6/16=37.5 per cent. Using the current-year measure, the job creation rate would be 100*6/19=31.58 per cent. On the other hand, assume Plant B with 40 employees, destroys 8 jobs in one year. Using the base-year measure, the job destruction rate would be 100*8/40=20 per cent. Using the current-year measure, the job destruction rate would be 100*8/36=25 per cent. Thus, the job creation rate would be higher under the base-size measure (smaller denominator) and the job destruction rate would be higher under the current-size measure (smaller denominator) if there were no inter-class movements (ie movements between size categories) from one time period to the next

To identify the extent of regression bias, Davis *et al.* (1996a; 1996b) use both the current size and average size[8] which is calculated as the plant's average employment across all periods for which the unit exists in the database, in addition to the base-size measure.

Table 3.2 Different measures of average annual net job creation rates and employment shares 1973-1988

Employment size class	Net job creation (Base-year)	Net job creation (Ave-year)	Net job creation (Current-year)	Employment share (Base-year)	Employment share (Ave-year)	Employment share (Current-year)
0 to 19	10.3	-1.3	-4.5	5.2	4.4	5.2
20 to 49	0.6	-1.1	-2.1	8.5	8.2	8.6
50 to 99	-0.7	-0.9	-1.3	10.4	10.1	10.5
100 to 249	-1.7	-1.4	-1.1	18.6	18.5	18.5
250 to 499	-2.5	-1.3	-1.0	16.0	16.6	16.0
500 to 999	-2.7	-1.0	-0.6	13.5	13.8	13.5
1000 to 2499	-2.6	-1.6	-1.0	12.3	12.5	12.3
2500 to 4999	-2.5	-1.7	-1.3	7.0	7.2	7.0
5000 to more	-2.4	-0.6	-0.2	8.5	8.8	8.4

Source: Davis *et al.* (1996a, p.69; 1996b, p.306).
Notes: The three measures are defined in the text. The denominator for the Average Year calculations is average employment over the sample period 1973-1988.

Table 3.2 shows the annual net job creation rate in the US manufacturing sector for the period 1973-1988 based on the three different measures calculated by Davis *et al.* (1996a, 1996b). The authors use the striking results in Table 3.2 to illustrate regression bias. Note that there are significant differences in the net job creation rates based on the base-year and current-year measures. For example, using the base-year measure, the smallest class (0 to 19) has the highest net job creation rate (10.3 per cent) over the sample period. However, using the current-year measure, the smallest class (0 to 19) has the lowest net job creation rate (-4.5 per cent) and the largest class (more than 500) has the highest net job creation rate (-0.2 per cent). The inconsistent results for the three measures suggest that there is a significant regression bias operating with respect to US manufacturing sector employment (Davis *et al.*, 1996a, 1996b).

However, the "indirect" evidence has attracted significant criticism from economists (ENSR, 1995; Kirchhoff, 1998; Davidsson *et al.*, 1998). For example, ENSR (1995) say "This criticism [regression fallacy] by Davis *et al.* has the most force. However, its quantitative significance needs to be evaluated". Davidsson *et al.* (1998) suggest that a majority of plants would stay in their own size category over time and would not be close to or cross the size boundary. As a result, there is a need to estimate the number of inter-class firms and their impact on overall job creation and destruction.

Table 3.3 Job flow rates in Canadian manufacturing sector 1970-88

Size class	Base-year	Current size	Previous period current size
0 to 19	11.3	1.9	13.0
20 to 49	3.8	3.2	4.5
50 to 99	0.7	2.0	1.0
100 to 249	-0.7	1.2	-0.5
250 to 499	-1.6	0.5	-1.6
500 to 999	-2.2	-0.1	-2.1
1000 to 2499	-1.7	-0.1	-1.6
2500 to 4999	-0.8	-0.4	0.1
5000 to more	-1.2	0.4	-1.3

Source: Baldwin and Picot, 1995, p. 330.
Notes: Previous period current size is defined as the average employment between the base-year and the year prior to the base year.

Baldwin and Picot (1995) provide an insightful discussion of the different measures. They conclude that the choice of method does influence the net job creation estimates for Canadian manufacturing (see Table 3.3). The authors propose another measure called the "Previous period current size" which averages the base-year and the year prior to the base year employment. The second and the fourth columns show that there is not much difference between base size and previous period current size measures. It is obviously that the extent of regression bias is determined by the characteristics of the data. Based on this data, the inter-class movement was not significant with respect to the Canadian data, and thus Davis *et al.*'s (1996a; 1996b)' claims were not supported, but inter-class movement may be important for US manufacturing. Moreover, Baldwin and Picot (1995) do not provide data on the number of inter-class movement and the extent of regression bias.

At the time of writing, Davidsson *et al.*'s (1998) paper is the only study using job flow data which directly examines the extent of regression bias. The authors correct the regression bias by measuring the actual number of jobs gained (lost) due to boundary-crossing firms, and then assigning half of the job change to the old size category and the other half to the new size category. Table 3.4 is taken from Davidsson *et al.* (1998). Their empirical results show that the job creation share of small business changed from 45.7 to 45.0 per cent after correcting for regression bias. In addition, the job destruction share associated with small business increased from 36.7 to 37.2 per cent. Also after correcting for 'regression bias', the share (45 per cent) of small business' job creation exceeds their employment share (34 per cent) by about 11 percentage points, and the share (45 per cent) of small business's job creation exceeds their job destruction share (37.2 per cent) about by 7.8 percentage points. Hence, Davidsson *et al.* (1998) suggest that the overestimation of small business job creation due to regression bias is small. Thus, the adjusted empirical results do not reject the job creating prowess of small business.

Table 3.4 Measures of small business job flows in Sweden[a], 1989-1994

Job gains:	
Aggregated small business gross job creation according to base-year measure over the six years:	952,867
-50% of all jobs created by small business that were large business by the end of the analysis year	- 25,205
+50% of all jobs created by large business that were small business by the end of the analysis year[b]	+ 8,922
Aggregated small business gross job creation corrected for regression bias over the six years	936,584
Small business's share of total job creation according to base-year measure	45.7%
Small business's share of total job creation corrected for regression bias	45.0%
Job losses:	
Aggregate small firm gross job destruction according to base-year measure:	926,090
+50% of all jobs lost by large business that were small business by the end of the analysis year	+ 26,540
-50% of all jobs lost by small business that were large business by the end of the analysis year[c]	- 14,907
Aggregate small business gross job destruction corrected for regression bias	937,723
Small business's share of total job destruction according to base-year measure	36.7%
Small business's share of total job destruction corrected for regression bias	37.2%

Source: Davidsson *et al.*, 1998, p. 97.

Notes: [a] Davidsson *et al.* (1998) aggregated the annual changes of gross job creation and destruction of small business over the six years.

[b] Davidsson *et al.* (1998) classify the small business at the firm level. In the firm with multiple establishments, contracting firm may have job creation due to the growth in some establishments within this firm.

[c] In the firm with multiple establishments, expanding firm may have job destruction due to the declined in some establishments within this firm.

Davis *et al.* (1996a; 1996b) and Davidsson *et al.* (1998) disagree about the extent of regression bias. Davis *et al.* (1996a; 1996b) support the hypothesis that regression bias has a significant effect on small business' net job creation rate (see Table 3.2), but Davidsson *et al.* (1998) argue that the extent of regression bias of small business should be ignored because it has a minimal impact on job creation and destruction shares. The absence of consistent results after correction for regression bias justifies the further exploration of the bias using the SEE dataset in Taiwan, which has a number of advantages over other datasets in the analysis of job dynamics (see Section 3.2), in particular the capacity to assign employment change associated with inter-class plants.

3.5 Adjusted base-size measure

While the possibility of regression bias has been acknowledged (Picot *et al.,* 1994; Davidsson *et al.,* 1998, Drnovsek, 2004), there is limited knowledge about the extent of this bias in the measurement of job creation and destruction. As noted, Davidsson *et al.* (1998) correct the job change figures by assuming that half of the job change is attributable to the old size class and the other half to the new size class. We do not adopt this assumption. The first step in correcting for possible regression bias is to count the jobs due to plants growing or declining into the next size class. The next step is to allocate these jobs to the old class and the new class(es), respectively. Table 3.5 and Table 3.6 show four examples which help to explain how the adjusted base-size measure allocates job creation and destruction across size classes.

Plant A, for example, with 15 employees, creates 12 jobs in one month. Using the base-month measure and 20 employees as the size boundary, the 12 new jobs would be assigned to Group 1 plants (between 0 and 19 employees). However, the current-month measure would assign the 12 jobs to Group 2 plants because the average employment for Plant A over the two months is 21 employees (ie between 20 and 49 employees). Using the adjusted base-month measure, 4 jobs would be assigned to Group 1 plants (between 0 and 19 employees) and 8 jobs to Group 2 plants (between 20 and 49 employees).

Table 3.5 Two examples of corrected inter-class growing plants

	Plant A	Base-month	Current-month	Adjusted Base-month
Jan employment	15			
Feb employment	27	15 (Group 1)	21 (Group 2)	
Job creation	12	12 (Group 1)	12 (Group 2)	4 (Group 1); 8 (Group 2)
	Plant B	Base-month	Current-month	Adjusted Base-month
Jan employment	15			
Feb employment	55	15 (Group 1)	35 (Group 2)	
Job creation	40	40 (Group 1)	40 (Group 2)	4 (Group 1); 30 (Group 2); 6 (Group 3)

On the other hand, assume that Plant B had 15 employees in January and 55 employees in February. Using the base-month measure and 50 employees as the next size boundary, the Group 1 plants (between 0 and 19 employees) create the 40 jobs. Using the current-month measure, the 40 jobs are assigned to Group 2 plants (between 20 and 49 employees) because the average employment for the two months is 35. Under the adjusted base-month measure, 4 jobs are assigned in Group 1 plants (between 0 and 19 employees), 30 jobs created are assigned to Group 2 plants (between 20 and 49 employees) and 6 jobs are assigned to Group 3 plants (between 50 and 99 employees).

From Table 3.6 we can see that Plant C with 120 employees in January destroys 42 jobs in February. Using the base-month measure and 100 employees as the size boundary we would attribute the 42 jobs destroyed to Group 4 plants (between 100 and 249 employees), whereas using the current-month measure, the same job destruction would be allocated to Group 3 plants (50 to 99 employees) since the current-month employment is 99. Under the adjusted base-month measure, the destruction of 21 jobs would be associated with Group 4 plants (between 100 and 249 employees) and the destruction of 21 jobs would be assigned to Group 3 plant (50 to 99 employees).

Table 3.6 Two examples of corrected inter-class shrinking plants

	Plant C	Base-month	Current-month	Adjusted Base-month
Jan employment	120			
Feb employment	78	120 (Group 4)	99 (Group 3)	
Job destruction	42	42 (Group 4)	42 (Group 3)	21 (Group 4); 21 (Group 3)
	Plant D	Base-month	Current-month	Adjusted Base-month
Jan employment	120			
Feb employment	30	120 (Group 4)	75 (Group 3)	
Job destruction	90	90 (Group 4)	90 (Group 3)	21 (Group 4); 50 (Group 3); 19 (Group 2)

Similarly, assume that Plant has 120 employees in January and destroys 90 jobs in February. Using the base-month measure and 50 employees as the size boundary, Group 4 plants (between 100 and 249 employees) destroy the 90 jobs. Using the current month measure, the destruction of 90 jobs is assigned to Group 3 plants (50 to 99 employees) because the average employment for these two months is 75. Under the adjusted base-month measure, 21 jobs are allocated to Group 4 plants (between 100 and 249 employees), 50 jobs are assigned to Group 3 plants (50 to 99 employees) and 19 jobs to Group 2 plants (20 to 49 employees).

In order to avoid regression bias, Davis *et al.* (1996a; 1996b) proposed the current-size measure, which is defined as the simple average of employment at t-1 and at t. Later researchers (for example, Tsou *et al.*, 2002) have used the current-size measure to try to avoid regression bias but no research has examined the relative effectiveness of this approach. The adjusted base-size approach is the correct way to assign inter-class employment change. The question then is whether the current measure is a reasonable approximation for this correct method of assignment.

3.6 Conclusion

In summary, this Chapter has discussed the source and characteristics of the SEE dataset which is used for the empirical work in this thesis. We have considered the strengths and weaknesses of the data relative to other datasets that have been employed in the literature.

The Chapter has defined the different measures of job creation and destruction, differentiated between base-size and current-size measures and introduced the concept of regression bias. Researchers disagree as to the significance of regression bias in studies of job creation and destruction. The Thesis has introduced the adjusted base-size measure which is able to provide a clear picture of the extent of regression bias in the measurement of job creation, job destruction and net employment growth.

In Chapter 4 the small business job creation hypothesis will be carefully outlined and the measures of job creation and destruction defined in this Chapter will be used to both investigate the hypothesis and to establish the degree of regression bias and the extent to which regression bias is corrected by the use of the current-size measure.

Appendix: Standard Industrial Classification System of Taiwan (2006)

Mining	
	Crude Petroleum and Natural Gas Extraction
	Sand, Stone and Clay Quarrying
	Other Mining and Quarrying
Manufacturing	
	Food, beverages and tobacco
	Textiles, Leather, Fur and Related Products Manufacturing
	Wood and Bamboo Products Manufacturing
	Petroleum, Coal, Rubber and Plastic Manufacturing
	Chemical Material and Chemical Products Manufacturing
	Medical Goods Manufacturing
	Basic Metal Manufacturing
	Computers, Electronic and Optical Products Manufacturing
	Electrical Equipment Manufacturing
	Furniture Manufacturing
	Manufacturing Not Elsewhere Classified
Utility	
	Electricity and Gas Supply
	Water Supply
Construction	
	Buildings Construction
	Civil Engineering
	Specialized Construction
Wholesale	
	Wholesale
	Retail Trade
Transportation	
	Land Transportation
	Water Transportation
	Air Transportation
Finance	
	Financial Intermediation
	Insurance Carriers
	Securities, Futures and Other Financing
Industrial Service	

	Computer Systems Design Services
	Software Design Services
	Research and development services
	Architecture and Engineering Services
	Technical Testing and Analysis Services
Social Service	
	Community Services
	Social Services
	Personal Services

Source: Directorate General of Accounting, Budget, and Statistics, Taiwan, 2006.

Notes:

[1] The survey on Earnings of Employees (SEE) commenced in January 1970 with the Manufacturing, Utility, Mining, Construction and Transportation sectors being surveyed. However, we only consider the data from 1987 to 2003 because the data from 1970 to 1986 are unavailable.

[2] For example, Plant A, with 90 employees, hires 30 workers in one month. Using the base-month measure and 100 employees as the size boundary, the 30 new jobs would be assigned to small business (less than 100 employees). However, using the current-month measure, the 30 jobs are assigned to large business because the average employment in Plant A over the two months is 110 employees. Thus, Plant A is classified as an inter-class plant. If 30 workers were to leave Plant A in the short term, say after six months, we would classify Plant A as a transitory inter-class entity. However, if Plant A stays in the large business size category (or even becomes larger) for a longer period we would classify Plant A as an inter-class plant over the long run.

[3] In each month, the SEE data only provides the current and previous employment levels for each plant. However, the sampling number of each plant has changes each month and, thus, a time series of employment for each plant is not available.

[4] The number of inter-class plants and their impact on job creation and destruction are measured on the basis of consecutive monthly observations.

[5] Other exits are measured as the sum of employees, who retrained, retired, died, suffered illness or transferred to other plants.

[6] In Chapter 4 we will frame the hypothesis more formally, prior to analyzing the Taiwanese dataset.

[7] Galton (1886) thought that he had made a discovery when he found the sons of tall fathers tended to be shorter than their fathers and the fathers of tall sons tended to shorter than their sons. He termed this phenomenon regression to the mean (Stigler, 1986). However, he failed to understand that the observed behaviour reflects the fact that the second observation is expected to be closer to the mean than the first. In the research on job creation, the firms that are classified as large in the base year (month) are more likely to employ transitory workers. Since these jobs are transitory, large businesses are more likely to contract in the following year. Likewise, the firms that are classified as small in the base year (month) are more likely to have experienced recent transitory increases in employment. Therefore, small businesses are more likely to expand in the following year, as illustrate in Figure 3.1 (Davis *et al.*, 1996a; 1996b).

[8] Some researchers (for example, Davidsson *et al.*, 1998) argue that the average size measure is preferable only if all size changes are random fluctuations (The employment adjustment at year *t* is unrelated to that at year *t*-1).

Chapter 4 Small Business Job Creation Hypothesis

4.1 Introduction

The purpose of this Chapter is to: i) review and critique the available research evidence from international studies; ii) formally outline the small business job creation hypothesis; iii) measure the extent of regression bias using the unique Taiwanese plant-level data set, based on the manufacturing, service and construction sectors; iv) re-examine the small business job creation hypothesis, drawing on iii), using the adjusted base-size measure; and v) check whether the use of the current-size measure adequately captures the impact of regression bias.

We find that base-size and current-size measures of job creation, job destruction and net job creation yield significantly different results which suggest significant regression bias, but that the preliminary conclusions from using the base month measure that small business is disproportionately responsible for job creation and destruction are robust across all three sectors. However regression bias is significant when the role of small business in net job creation across the three sectors is considered. The current size measure adequately addresses regression bias with respect to job creation and job destruction, but this form of approximation is less accurate when net job creation is considered.

In the next section, the international studies are critically assessed. In Section 4.3 measures of job flows using both base month and current size measures are computed for the 3 sectors using the Taiwanese dataset. We then estimate the average number of inter-class plants and their contribution to employment change. This leads to an investigation of the impact of regression bias on calculations of job creation, job destruction and net job creation in Section 4.5. Also the adequacy of the current month measure as an approximation for the correct assignment of employment change across plant sizes is considered in this section. Concluding comments follow.

4.2 International Studies

Birch (1979) uses the base-size measure of job creation and destruction and finds that small business created 82 per cent of net new jobs in US. It was this result that gave rise to the small business job creation hypothesis, namely that small business outperforms large business with respect to job creation.

Since Davis *et al.* (1996a; 1996b) made the contentious claim that the alleged dominance of small business in job creation was based on methodological fallacies[1], studies in many countries have contributed to the debate (Baldwin and Picot, 1995; Carree and Klomp, 1996; Davidsson, 1994; 1995, 1996; ENSR, 1995; Gallagher and Robson, 1995; Kirchhoff and Greene, 1995, 1998; OECD, 1994, 1996; Storey, 1995; Davidsson *et al.,* 1998).

Davis *et al.* (1996a; 1996b) use the Longitudinal Research Database (LRD) to challenge the small business job creation hypothesis. They analyse the US manufacturing sector from 1973 to 1988 and find that small business in the manufacturing sector exhibits a higher gross job creation rate but large business accounts for a larger share of newly-created manufacturing jobs. They show that the finding that small business outperforms large business with respect to job creation was based on three major methodological flaws. The first two flaws, which are explored in Appendices A and B, are easy to discard because the bias they impart to the results does not systematically favour small business (Davidsson *et al.*, 1998). The most interesting and debated issue involves the third flaw – the so-called regression fallacy which we considered in Chapter 3.

Following the work of Davis's *et al.* (1996a; 1996b), there have been a number of international studies, which have re-examined the small business job creation hypothesis. However, the empirical results are not consistent. Konings (1995) use the Workplace Industrial Relations Survey (WRIS) of 1980, 1984 and 1990 of plant level employment data in UK and finds that the gross job creation rate is higher in small business but large business creates the most jobs, which is consistent with Davis *et al.* (1996a; 1996b). By contrast, Baldwin and Picot (1995) have studied job flows by establishment size in the Canadian manufacturing sector from 1970 to 1990. They find that small business with less than 100 employees has a higher gross job creation rates and small business also accounts for a larger share of gross job creation than large business. In a German study Wagner (1995) obtains similar results using current-size measures; and so do Broersma and Gautier (1997) for the Netherlands; Genda (1998) for Japan; and Hohti (2000) for Finland.

Borland and Home (1994) use annual data to investigate the small business job creation hypothesis in the Australian manufacturing sector from 1984 to 1985. By contrast, they find that, using the current-size measure, the rates of job creation and destruction are higher in large business and that large business is responsible for a higher share of job creation. Recently, Juniper *et al.* (2004) came to the same conclusion with the Australian Bureau of Statistics (ABS) Business Longitudinal Survey (BLS) dataset from 1994-95 to 1997-98. Moreover, they also find that industrial variables are significant and negatively signed in a job destruction regression which indicates that job destruction rates are lower in those firms with higher wage rates and wider award wage coverage; higher union coverage and higher rates of workers' compensation.

In Taiwan, Tsou *et al.* (2002) use annual data to examine the cyclical behaviour of job reallocation and worker turnover in the manufacturing sector from 1981 to 1994. They find that gross job creation and job destruction based on current size measures are higher in small plants than large ones, but large plants dominate with respect to their shares of job creation and destruction.

Recently, Neumark *et al.* (2008) employ a new database, the National Establishment Time Series (NETS) from 1992 to 2004, to re-examine the small business job creation hypothesis in the US. They find that small firms have higher share of net job creation than large firms for the overall economy. Furthermore, Neumark *et al.* (2008) find that the base-year size definition proposed by Birch (1979) indeed overestimates the net job creation rates for small firms.

These studies are not without limitations. First, most studies focus on the manufacturing sector (for example, Baldwin and Picot, 1995; Broersma and Gautier, 1997; Hohti, 2000; Tsou *et al.*, 2002). The results derived from the manufacturing sector are not necessarily representative of the overall economy (see Ritter, 1994 for evidence of this for the US). Thus, the examination of the small business job creation hypothesis in the service sector merits consideration. Second, although some approaches[2] (for example, Baldwin and Picot, 1995; Konings, 1995, Davidsson *et al*, 1998) have been developed to deal with regression bias, the extent of regression bias is still largely unknown. Third, the empirical results derived from annual data may involve the netting out problem which we considered in Section 3.2.

Fourth, as we have discussed above, previous studies which examined the hypothesis compared both rates and shares of job creation and destruction, and, in some cases found inconsistent results. The job creation rate indicates the relative job growth performance across size classes. In contrast, the job creation (destruction) share reveals the distribution of gross job creation (destruction) across size classes, which will reflect in part the size distribution of plants. Hence, while the job creation (destruction) rate and job creation (destruction) share are useful summary measures, they are not equivalent with respect to the job creation (destruction) hypothesis.

Some studies support the small business job creation hypothesis with respect to rates, but not shares. This is clearly unsatisfactory. However if the 'share version' of the small business job creation hypothesis is reframed in terms of the shares of job creation (destruction) *relative to corresponding employment share*, then the two versions of the hypothesis are equivalent. This can be readily demonstrated. Assume that all plant sizes are classified as small or big business and that small business has a higher rate of job creation than large business, then

(4.1) $jc^s / e^s > jc / e > jc^l / e^l$

where the superscripts, s, l denote small and large business respectively and jc, e (without subscripts) denote (total) job creation and (total) employment, respectively. Thus

(4.2) $jc^s / jc > e^s / e$

and

(4.3) $jc^l / jc < e^l / e$

Thus, if small business has a higher rate of job creation than the overall average, and hence greater than the large business rate of job creation, its share of total job creation exceeds its share of total employment, and conversely for large business. Thus the two versions of the small business job creation hypotheses are equivalent, as long as we measure the job creation share relative to its corresponding employment share.

In the case of Taiwan, for example, Tsou *et al.* (2002) show that the manufacturing sector is dominated by large business, so they have a larger share of job creation and destruction, but a low job creation rate. The explanation for the inconsistency of the two representations of the small business job creation hypothesis is that, relative to total employment in large business, its share of job creation (destruction) is lower than expected and thus consistent with the low rate of job creation (destruction).

Fifth, while small business may have a higher rate of gross job creation, this does not mean that it is also more dynamic with respect to net job creation, which is the source of sustained employment growth. Konings (1995) find that the net job creation rate in UK is higher in small business. Similar results are found for Baldwin and Picot (1995) in Canada, Broersma and Gautier (1997) in Netherlands, Genda (1998) in Japan and Tsou *et al.* (2002) in Taiwan. By contrast, Davis *et al.* (1996a, 1996b) find that small business is not characterised by a higher net job creation rate in US. Broersma and Gautier (1997) obtain similar results to Davis *et al.* (1996a, 1996b) in Netherlands and so do Wagner (1995) for Germany, Hohti (2000) for Finland. Moreover, Borland and Home (1994) find that establishments with more than 500 employees contribute a greater share of net job creation relative to their share of employment in Australia. Hohti (2000) finds that the large business contributes a higher net job creation share compared to its employment share. As we have discussed above, the net job creation rate and share are useful summary measures, but they are not equivalent with respect to the job creation hypothesis. Thus, we must measure the net job creation share of small business relative to its corresponding employment share in order to frame the hypothesis about small business net job creation in a form which is equivalent to the small business job creation and destruction hypotheses.

4.3 Job flows by plant size in three sectors

This Section analyses job flows by establishment size in the manufacturing, service and construction sectors in Taiwan. We employ the base-month and current-month measures[3] to explore the small business job creation hypothesis that job creation (destruction) rates of small business are higher than the corresponding rates for large business, which is equivalent to small business having a disproportionately high share of job creation (destruction). The job creation rate for say the smallest size category (< 5 employees) is calculated as the monthly average of the {number of jobs created by plants with less than 5 employees}/total number of employees in plants with less than 5 employees in the base month. The job destruction and net creation rates are analogously defined.

The size boundaries and the definition of small business used in this Thesis are based on the criteria used for Small and Medium Enterprises (SMEs) in the Taiwanese Small and Medium Enterprises Administration (SMEA) as well as by the Asian-Pacific Economic Cooperation (APEC). Appendix C provides a summary of the various definitions of small and medium enterprises (SMEs) across different countries, the majority of which are members of APEC.

Various economic variables are used as a proxy for size in order to define SMEs. For example, size could be based on the number of employees, the amount of invested capital, or the total value of assets. The most commonly used variable is the number of employees. However, there is no consistent definition of SMEs in terms of the number of employees. A common demarcation is to define SMEs in APEC economies as plants with less than 100 employees (APEC, 2002). Moreover, the definition of SMEs is different in the Taiwanese manufacturing and service sectors. SMEA (2007) define SMEs as those firms that have less than 200 employees in the manufacturing sector and less than 50 employees in the service sector. In general, the definition of SMEs used by APEC is adopted in this Thesis.

4.3.1 Manufacturing

Table 4.1 Average job flow rates (%) and shares per month by plant size in the manufacturing sector, 1987-2003

Plant size	NET[a]	JC[a]	JD[a]	JR[b]	JC share[c]	JD share[d]	Employment share[e]
				A. Base-month measure			
<5	6.85	9.05	2.21	11.26	0.42	0.08	0.06
5 to 19	0.27	2.59	2.32	4.91	2.08	1.63	0.98
20 to 49	-0.11	2.14	2.25	4.39	6.28	5.86	3.54
50 to 99	-0.27	1.69	1.96	3.65	10.32	10.62	7.32
100 to 199	-0.25	1.48	1.73	3.22	16.60	17.31	13.23
200 to 499	-0.24	1.23	1.47	2.70	26.89	28.74	25.93
>500	-0.06	0.93	0.99	1.92	37.40	35.75	48.93
				B. Current-month measure			
<5	-0.34	3.42	3.76	7.18	0.16	0.12	0.06
5 to 19	-0.74	2.14	2.88	5.01	1.69	1.98	0.97
20 to 49	-0.58	1.94	2.52	4.46	5.65	6.47	3.53
50 to 99	-0.44	1.65	2.09	3.73	9.98	11.21	7.33
100 to 199	-0.35	1.45	1.80	3.24	16.00	17.80	13.23
200 to 499	-0.20	1.26	1.46	2.72	27.44	28.38	25.93
>500	0.02	0.98	0.95	1.93	39.09	34.04	48.94

Source: Survey on Earnings of Employees (SEE) dataset.
Notes: [a] NET is the net job creation rate, which is the job creation rate (JC) minus the job destruction rate (JD). [b] JR is the job reallocation rate, which the sum of the job creation and destruction rates. [c] JC share is the job creation share. [d] JD share is the job destruction share. [e] The employment shares across plant sizes are slightly different because of different definitions of base-size and current-size measures (See Chapter 3). Table entries for the job creation and destruction rates, job creation and destruction shares and the employment shares are the means of monthly values for the period 1987 to 2003.

The results in Table 4.1 are similar to those for the US derived by Davis *et al.* (1996a, 1996b). Using the base-month measure (Panel A), the smallest size category has the highest net job creation rate (6.85 per cent), whereas, using the current-month measure (Panel B), the same size category delivers a negative net job creation rate (-0.34 per cent). Moreover, the largest size category has the highest net job creation rate (0.02 per cent) in Panel B, but it has a negative net job creation rate (-0.06 per cent) in Panel A. Thus, using the base-month measure, which ignores the movements of plants between size classes over time, produces an overly favourable picture of the relative growth performance of small business.

There are two reasons for this outcome. First, the base-month and current-month measures assign plants differently between size categories when the plants move across the size boundaries. The base-month measure credits each plant's employment change to the size class at *t*-1 (Birch, 1979); whereas the current-month measure credits the plant's employment change to the average size class at *t*-1 and *t* (Davis and Haltiwanger, 1992). Second, the base-month and current-month measures use different denominators which also impact on the computation of job creation and destruction rates. Taken together, these reasons explain why job creation rates tend to be higher and job destruction lower using the base size measure, as shown in Columns 3 and 4, which in turn means that the net job creation rates are also higher. Job creation (destruction) rates are not *systematically* higher (lower) under the base-size measure, because of the possibility of inter-class plants being reclassified under the current-size measure, as described above.

From Table 4.1 we also see that the job creation rate is a declining function of plant size, irrespective of the measure being used. In Panel B (current-size measure), job creation (destruction) rates are systematically higher for small business (less than 100 employees) as compared to large business which provides support for the job creation hypothesis.

This can be confirmed by inspecting the relative shares of job creation (destruction) across small and large business.

Large business dominates job creation and destruction in both Panel A and Panel B. In Panel B, plants with more than 100 employees represent nearly 83 per cent of total job creation and about 80 per cent of job destruction[4]. This is not surprising because large business with more than 100 employees accounted for 88 per cent of employment over the period 1987-2003. In fact, small business has a larger share of both gross job creation and gross job destruction, than would be expected given its share of total manufacturing employment which confirms that small business has higher job creation and destruction rates. Thus the manufacturing data support the small business job creation and destruction hypotheses.

Our results are also consistent with other Taiwanese research in this area. Tsou *et al.* (2002) use a Taiwanese dataset based on annual labour turnover surveys in the manufacturing sector over the period 1981-1994. The job creation and destruction rates are higher among small plants. Although large business with more than 100 employees dominates total job creation and destruction, the job creation and destruction shares of large business with more than 100 employees are lower relative to the corresponding employment share. Moreover, the gross annual job creation rates were five to seven times greater than the monthly rates in Table 4.1 and the annual job destruction rates were four to six times larger than monthly rates. This is plausible since the annual data account for the overall change over 12 months.

4.3.2 Services

Table 4.2 shows job creation and destruction rates associated with the base-month and current-month measures in the service sector from 1987 to 2003. The marked differences between job creation and net job creation rates across the two measures are mainly a consequence of the base level being used as a denominator in base-size measure and an average being used in the other. Using the base-month measure (Panel A), the smallest size category has the highest job creation rate (4.52 per cent) whereas using the current-month measure (Panel B) the same size category has the second highest job creation rate (1.34 per cent). Moreover, using the base-month measure (Panel A), the highest net job creation rate (3.41 per cent) is obtained in the smallest size category whereas using the current-month measure (Panel B) the same size category delivers a negative net job creation rate (-0.16 per cent).

Table 4.2 Average job flow rates (%) and shares per month by plant size in the service sector, 1987-2003

Plant size	NET	JC	JD	JR	JC share	JD share	Employment share
				A. Base-month measure			
<5	3.41	4.52	1.11	5.64	1.55	0.53	0.31
5 to 19	0.07	1.61	1.54	3.15	4.21	4.82	1.97
20 to 49	-0.06	1.34	1.40	2.73	7.86	9.72	4.39
50 to 99	-0.11	1.19	1.29	2.48	8.00	10.38	5.03
100 to 199	0.00	1.16	1.16	2.31	9.13	10.83	5.90
200 to 499	0.17	1.08	0.91	1.99	15.96	16.07	11.14
>500	0.15	0.56	0.41	0.96	53.29	47.64	71.26
				B. Current-month measure			
<5	-0.16	1.34	1.50	2.84	0.49	0.68	0.31
5 to 19	-0.31	1.45	1.76	3.22	3.77	5.50	1.96
20 to 49	-0.16	1.30	1.45	2.75	7.61	10.12	4.38
50 to 99	-0.04	1.23	1.27	2.50	8.31	10.24	5.04
100 to 199	0.04	1.17	1.14	2.31	9.28	10.65	5.89
200 to 499	0.17	1.08	0.91	1.98	15.93	16.05	11.14
>500	0.17	0.57	0.40	0.97	54.61	46.77	71.30

Notes: see Table 4.1

The smaller size categories also have larger job creation rates than the large plants using both measures (compare Panels A and B in Table 4.2). For example, in Panel B, the job creation rate averaged 1.34 per cent of employment per month for plants with fewer than 5 employees and 0.57 per cent for plants with more than 500 employees. Turning to the fourth column in Panel B, the smaller size categories also have higher job destruction rates than larger size categories. In Panel B, the job destruction rate averaged 1.50 per cent per month for plants of fewer than 5 employees and 0.40 per cent for plants with more than 500 employees.

Large business plays the dominant role in job creation and destruction, irrespective of which measure (base-month or current-month) is used. Inspection of Panel B reveals that plants with more than 100 employees account (on average) for nearly 80 per cent of total job creation and over 73 per cent of total job destruction, but these plants accounted for over 88 per cent of total employment over the 1987-2003 period. These data confirm that large plants (over 100 employees) have lower job creation and destruction rates than other plant sizes. Thus, small business “over” contributed to job creation and destruction relative to its employment share, which provides support for the job creation and destruction hypotheses.

4.3.3 Construction

At the time of writing there were no other studies exploring the behaviour of job creation and destruction in the construction sector in a newly industrializing economy such as Taiwan. Our findings for construction in Table 4.3 are consistent with those for the manufacturing and service sectors. Small business in the construction sector also create**s** and destroy**s** new jobs at a much higher gross rate than large business and thus is disproportionately responsible for job creation and destruction relative to its employment share. This is reflected in the relative shares of job creation and job destruction for small business. Plants with less than 100 employees contribute 57 per cent of total job creation and 57 per cent of total job destruction as calculated by the current-month measure, although they only represent 40 per cent of total employment.

Table 4.3 Average job flow rates (%) and shares per month by plant size in the construction sector, 1987-2003

Plant size	NET	JC	JD	JR	JC share	JD share	Employment share
			A. Base-month measure				
<5	7.45	9.58	2.12	11.70	5.05	1.09	1.27
5 to 19	0.97	4.15	3.18	7.33	17.10	11.86	9.33
20 to 49	-0.05	3.25	3.30	6.55	22.99	20.69	15.47
50 to 99	-0.33	2.87	3.21	6.08	19.05	18.94	14.32
100 to 199	-0.47	2.61	3.08	5.68	15.00	16.29	12.76
200 to 499	-0.98	1.94	2.92	4.86	10.72	14.78	12.84
>500	-0.51	0.67	1.19	1.86	10.10	16.36	34.01
			B. Current-month measure				
<5	-0.24	3.57	3.82	7.39	1.89	1.85	1.25
5 to 19	-0.48	3.30	3.78	7.07	13.55	14.07	9.31
20 to 49	-0.39	3.11	3.50	6.61	21.81	22.05	15.49
50 to 99	-0.07	3.03	3.10	6.12	20.00	18.65	14.37
100 to 199	-0.10	2.99	3.09	6.08	17.77	16.28	12.79
200 to 499	0.24	2.68	2.44	5.13	14.55	11.95	12.90
>500	-0.41	0.69	1.10	1.80	10.44	15.15	33.90

Notes: see Table 4.1

4.4 Inter-class plants

The previous section examined the job creation (destruction) hypothesis for the three sectors by using base and current month measures. The results show that despite the impact on the computed rates of job creation and destruction from using the current month measure to correct for regression bias, the evidence supports the claim that small business is disproportionately responsible for both job creation and job destruction. In next two sections we will establish inter alia whether the current month measure adequately addresses regression bias, so that it can be used to explore the job creation hypothesis.

The first purpose of this section is to examine the average number of plants which moved to a new size class after employment change during the corresponding month. The second purpose of this section is to examine the magnitude of job creation and destruction due to plants moving across one or more size boundaries in the following month using the base-month measure.

Table 4.4 shows that the average number of inter-class plants in each sector is small. For example, in the manufacturing sector, an average of 16.46 plants crossed the size boundary from Class 4 (50 to 99 employees) to Class 5 (100 to 199 employees) in the following month. However, there are, on average, 747 plants in Class 4 (50 to 99 employees). On the other hand, in the manufacturing sector, an average of 16.80 Class 5 plants (100 to 199 employees) were classified as Class 4 (50 to 99 employees) in the following month. Hence, these results[5] indicate that the majority of plants remain in the same size category from one month to the next, which supports the claim of Davidsson *et al.* (1998, p.90) based on Swedish data[6].

Table 4.4 Average number of inter-class plants per month (1987-2003)

Size classification[a]	Sample[b]	(1) <5	(2) 5 to 19	(3) 20 to 49	(4) 50 to 99	(5) 100 to 199	(6) 200 to 499	(7) >500
A. Manufacturing								
(1) <5	140	-	5.24 (3.74)	0.24 (0.17)	0.05 (0.04)	-	-	-
(2) 5 to 19	577	2.42 (0.42)	-	14.20 (2.46)	0.13 (0.02)	0.04 (0.01)	-	-
(3) 20 to 49	780	0.29 (0.04)	10.48 (1.34)	-	18.71 (2.40)	0.15 (0.02)	0.03 (0.004)	-
(4) 50 to 99	747	0.06 (0.01)	0.47 (0.06)	15.71 (2.10)	-	16.46 (2.20)	0.05 (0.01)	-
(5) 100 to 199	691	-	0.14 (0.02)	0.36 (0.05)	16.80 (2.43)	-	12.32 (1.78)	0.03 (0.004)
(6) 200 to 499	627	-	-	0.09 (0.01)	0.19 (0.03)	13.01 (2.07)	-	4.96 (0.79)
(7) >500	298	-	-	-	0.01 (0.003)	0.05 (0.02)	5.17 (1.73)	-
B. Services								
(1) <5	557	-	7.83 (1.41)	0.25 (0.04)	0.12 (0.02)	-	-	-
(2) 5 to 19	923	3.05 (0.33)	-	10.96 (1.19)	0.10 (0.01)	0.02 (0.002)	-	-
(3) 20 to 49	725	0.21 (0.03)	6.77 (0.93)	-	9.40 (1.30)	0.09 (0.01)	-	-
(4) 50 to 99	395	0.03 (0.01)	0.17 (0.04)	6.48 (1.64)	-	4.98 (1.26)	0.03 (0.01)	0.01 (0.003)
(5) 100 to 199	228	-	0.02 (0.01)	0.09 (0.04)	3.81 (1.67)	-	2.91 (1.28)	0.01 (0.004)
(6) 200 to 499	191	-	-	0.03 (0.02)	0.03 (0.02)	2.04 (1.07)	-	1.54 (0.81)
(7) >500	172	-	-	-	-	0.01 (0.01)	1.09 (0.63)	-
C. Construction								
(1) <5	179	-	7.76 (4.34)	0.23 (0.13)	0.04 (0.02)	-	-	-
(2) 5 to 19	356	4.55 (1.28)	-	8.74 (2.46)	0.28 (0.08)	0.04 (0.01)	-	-
(3) 20 to 49	212	0.19 (0.09)	6.84 (3.23)	-	5.34 (2.52)	0.23 (0.11)	0.02 (0.01)	-
(4) 50 to 99	91	0.01 (0.01)	0.25 (0.27)	4.71 (5.18)	-	2.38 (2.62)	0.09 (0.10)	-
(5) 100 to 199	41	-	0.04 (0.10)	0.19 (0.46)	2.29 (5.59)	-	0.94 (2.29)	0.01 (0.02)
(6) 200 to 499	19	-	-	0.04 (0.21)	0.08 (0.42)	0.95 (5.00)	-	0.17 (0.89)
(7) >500	8	-	-	-	-	-	0.18 (2.25)	-

Notes: [a] In both months, each plant was assigned to a size category based on its employment level.
[b] The average size distribution of plants over the sample period using the base-month measure. Figures in parentheses represent the corresponding percentages of total plants in that size classification.

Although we have found that the average number of inter-class plants in each size category per month is small, we now need to measure the job creation and job destruction associated with these inter-class plants.

Table 4.5 and Table 4.6 reveal that the proportion of job creation and job destruction associated with the inter-class plants is large. For example, in the manufacturing sector, there are, on average, 715 jobs created in Class 4 plants (50 to 99 employees) that are associated with these plants remaining in Class 4. Moreover, 220 new jobs are associated with the inter-class plants that crossed the size boundary from Class 4 plants (50 to 99 employees) to Class 5 plants (100 to 199 employees) in the following month using the base-month measure. There are, on average, 8 new jobs created in Class 4 plants (50 to 99 employees) that are associated with the inter-class plants that crossed the size boundary from Class 4 plants (50 to 99 employees) to Class 6 plants (200 to 499 employees) in the following month. On average Class 4 plants (50 to 99 employees) created a total of 947 new jobs per month from 1987 to 2003. This means that 23 per cent of job creation in the Class 4 plants (50 to 99 employees) is associated with some of these plants moving into the Class 5 size category (100 to 199 employees) in the following month. Moreover, Table 4.5 shows that the proportion of job creation due to inter-class plants is negatively related to size class. This indicates that the estimates of gross job flows for smaller class plants are more likely to suffer from regression bias. Similar conclusions can be drawn for the service and the construction sectors.

Table 4.5 and Table 4.6 also show the proportion of job creation that is allocated to the current and new class(es) when the adjusted base-size measure[7] is used. For example, in the manufacturing sector, there are, on average, 220 jobs created by the inter-class plants that crossed the size boundary from Class 4 plants (50 to 99 employees) to Class 5 plants (100 to 199 employees) in the following month. In terms of the adjusted base-size measure, 125 jobs reflect the initial employment levels of these Class 4 plants (50 to 99 employees) and 95 jobs would be counted in the Class 5 plants (100 to 199 employees).

Table 4.5a Average monthly total job creation due to inter-class plants assigned to different class sizes (1987-2003)

Base[a]	Base-F[b]	(1) <5	(2) 5 to 19	(3) 20 to 49	(4) 50 to 99	(5) 100 to 199	(6) 200 to 499	(7) >500
A. Manufacturing								
(1) <5	38.9	9.5(24%)	19 (49%) (1) 5.3 (2) 13.7	6.4(16%) (1) 0.9 (2) 3.5 (3) 2	4(11%) (1) 0.2 (2) 0.7 (3) 1.4 (4) 1.7	-	-	-
(2) 5 to 19	192.2	-	114(59%)	65 (34%) (2) 22 (3) 43	6.9(4%) (2) 0.7 (3) 4 (4) 3	5.3(3%) (2) 0.2 (3) 1.2 (4) 2 (5) 1.9	-	-
(3) 20 to 49	576.7	-	-	408(71%)	147(25%) (3) 59 (4) 88	13(2%) (3) 1 (4) 8 (5) 4	8.7(2%) (3) 0.5 (4) 1.7 (5) 3.4 (6) 3.1	- -
(4) 50 to 99	946.6	-	-	-	715(76%)	220(23%) (4) 95 (5) 125	8(0.6%) (4) 1 (5) 5 (6) 2	3.6(0.4) (4) 0.2 (5) 0.5 (6) 1.5 (7) 1.4
(5) 100 to 199	1523	-	-	-	-	1190(78%)	320(21%) (5) 138 (6) 182	13(1%) (5) 4 (6) 7 (7) 2
(6) 200 to 499	2467	-	-	-	-	-	2177(88%)	290(12%) (6) 137 (7) 153
(7) >500	3432	-	-	-	-	-	-	3432(100)
B. Service								
(1) <5	64.6	16(25%)	20 (31%) (1) 5 (2) 15	8(12%) (1) 1 (2) 4 (3) 3	20.6(32%) (1) 0.2 (2) 1.8 (3) 3.6 (4) 15	-	-	-
(2) 5 to 19	176.3	-	119(67%)	47 (27%) (2) 16 (3) 31	6(3%) (2) 1 (3) 3 (4) 2	4.3(2%) (2) 0.2 (3) 0.6 (4) 1 (5) 2.5	-	-
(3) 20 to 49	328.5	-	-	249(76%)	70(21%) (3) 27 (4) 43	8(2.6%) (3) 1 (4) 4 (5) 3	1.5(0.4%) (3) 0.1 (4) 0.3 (5) 0.6 (6) 0.5	- -
(4) 50 to 99	333.3	-	-	-	263(78%)	60(18%) (4) 27 (5) 33	5(2%) (4) 1 (5) 3 (6) 1	5.4(2%) (4) 0.1 (5) 1 (6) 3 (7) 1.2
(5) 100 to 199	380	-	-	-	-	308(81%)	68(18%) (5) 31 (6) 37	4(1%) (5) 1 (6) 2 (7) 1
(6) 200 to 499	664	-	-	-	-	-	582(88%)	81(12%) (6) 33 (7) 49
(7) >500	2218	-	-	-	-	-	-	2218(100)

Source: Survey on Earnings of Employees (SEE) dataset.

Note: Shares of job creation due to inter-class plants are in parentheses. [a] The class was classified by the base-month measure. [b] The class was classified by the base-month measure in the following month.

Table 4.5b Average monthly total job creation due to inter-class plants assigned to different class sizes (cont.)

Base[a]	Base-F[b]	(1) <5	(2) 5 to 19	(3) 20 to 49	(4) 50 to 99	(5) 100 to 199	(6) 200 to 499	(7) >500
C. Construction								
(1) <5	50.7	10(20%)	32 (62%) (1) 9 (2) 23	5.5(11%) (1) 0.4 (2) 3.5 (3) 3.6	3.2(7%) (1) 0.1 (2) 0.6 (3) 1.2 (4) 1.3	-	-	-
(2) 5 to 19	170.1	-	83 (49%)	65(38%) (2) 24 (3) 41	15(9%) (2) 2 (3) 8 (4) 5	7.1(4%) (2) 0.3 (3) 1.3 (4) 2.2 (5) 3.3	-	-
(3) 20 to 49	227.4	-	-	129(56%)	74(33%) (3) 32 (4) 42	20(9%) (3) 3 (4) 11 (5) 6	4.4(2%) (3) 0.4 (4) 1 (5) 2 (6) 1	- -
(4) 50 to 99	200.9	-	-	-	114(57%)	67(33%) (4) 29 (5) 38	17(8%) (4) 2 (5) 9 (6) 6	2.9(2%) (4) 0.2 (5) 0.6 (6) 1.8 (7) 0.3
(5) 100 to 199	150	-	-	-	-	92(60%)	53(37%) (5) 24 (6) 29	5(3%) (5) 1 (6) 2 (7) 2
(6) 200 to 499	105	-	-	-	-	-	89(84%)	16(16%) (6) 5 (7) 11
(7) >500	100	-	-	-	-	-	-	100(100)

Source: Survey on Earnings of Employees (SEE) dataset.
Note: See Table 4.5a

Table 4.6a Average monthly total job destruction based on assignment of employment change from inter-class plants (1987-2003)

Base[a] \ Base-F[b]		(1) <5	(2) 5 to 19	(3) 20 to 49	(4) 50 to 99	(5) 100 to 199	(6) 200 to 499	(7) >500
A. Manufacturing								
(1) <5	8	8(100%)	-	-	-	-	-	-
(2) 5 to 19	148	10(7%) (1) 3 (2) 7	138(93%)	-	-	-	-	-
(3) 20 to 49	607	8(1%) (1) 1 (2) 4 (3) 3	83(14%) (2) 35 (3) 48	516(85%)	-	-	-	-
(4) 50 to 99	1101	3.3(0.3%) (1) 0.1 (2) 0.8 (3) 1.6 (4) 0.8	27(2.7%) (2) 4 (3) 14 (4) 9	174(16%) (3) 81 (4) 93	897(81%)	-	-	-
(5) 100 to 199	1793	-	19(1%) (2) 1 (3) 4 (4) 7 (5) 7	34(2%) (3)4 (4)18 (5)12	274(15%) (4) 124 (5) 150	1466(82%)	-	-
(6) 200 to 499	2980	-	-	24(1%) (3)2 (4)5 (5)9 (6)8	40(1%) (4) 5 (5) 19 (6) 16	378(13%) (5) 172 (6) 206	2538(85%)	-
(7) >500	3705	-	-	-	7.9(0.2%) (4)0.4 (5)1 (6)2 (7)4.5	25(0.8%) (5) 1 (6)10 (7)14	294(8%) (6) 148 (7) 146	3378(91%)
B. Service								
(1) <5	19	19(100%)	-	-	-	-	-	-
(2) 5 to 19	173	14(8%) (1) 5 (2)9	159(92%)	-	-	-	-	-
(3) 20 to 49	336	5.8(2%) (1) 0.5 (2) 3.1 (3) 2.2	47(14%) (2) 22 (3) 25	283(84%)	-	-	-	-
(4) 50 to 99	358	2.3(1%) (1) 0.1 (2) 0.5 (3) 1 (4) 0.7	8(2%) (2) 1 (3) 5 (4) 2	65(18%) (3) 31 (4) 34	283(79%)	-	-	-
(5) 100 to 199	376	-	3.3(1%) (2) 0.3 (3)0.7 (4) 1.3 (5) 1	9(3%) (3)1 (4)5 (5)3	61(16%) (4) 29 (5) 32	302(80%)	-	-
(6) 200 to 499	555	-	-	7(1%) (3)1 (4)1 (5)3 (6)2	5(1%) (4) 1 (5) 3 (6) 1	47(9%) (5) 20 (6) 27	496(89%)	-
(7) >500	1648	-	-	-	2.7(0.2%) (5)0.5 (6)1 (7)1.2	5(0.3%) (5) 1 (6)2 (7)2	69(4.2%) (6) 25 (7) 44	1571(95.3%)

Source: Survey on Earnings of Employees (SEE) dataset.

Notes: Shares of job destruction due to inter-class plants are in parentheses. [a] The class was classified by the base-month measure. [b] The class was classified by the base-month measure in the following month.

Table 4.6b Average monthly total job destruction based on assignment of employment change from inter-class plants (1987-2003)

Base[a] \ Base-F[b]		(1) <5	(2) 5 to 19	(3) 20 to 49	(4) 50 to 99	(5) 100 to 199	(6) 200 to 499	(7) >500
C. Construction								
(1) <5	14	14(100%)	-	-	-	-	-	-
(2) 5 to 19	131	27(21%) (1) 10 (2) 17	104(79%)	-	-	-	-	-
(3) 20 to 49	227	5.1(2%) (1) 0.5 (2) 2.8 (3) 1.8	70(31%) (2) 31 (3) 39	152(67%)	-	-	-	-
(4) 50 to 99	198	1(1%) (2) 0.2 (3) 0.4 (4) 0.4	14(6%) (2) 2 (3) 8 (4) 4	79(38%) (3) 28 (4) 41	114(55%)	-	-	-
(5) 100 to 199	179	-	4.8(2%) (2) 0.3 (3) 1.2 (4) 2 (5) 1.4	18(10%) (3)3 (4)9 (5)6	62(35%) (4) 28 (5) 34	94(53%)	-	-
(6) 200 to 499	201	-	-	11(7%) (3)1 (4)2 (5)4 (6)4	17(10%) (4) 2 (5) 8 (6) 7	57(35%) (5) 25 (6) 32	79(48%)	-
(7) >500	178	-	-	-	-	1.8(1%) (5) 0.1 (6)1 (7)0.7	16(9%) (6) 9 (7) 7	160(90%)

Source: Survey on Earnings of Employees (SEE) dataset.
Notes: See Table 4.6a

4.5 Regression bias

The purpose of this Section is to use the base-month and adjusted base-month measures to calculate the extent of regression bias in calculations of gross and net job creation (employment change) for small business in Taiwan over the period 1987 to 2003. After correcting for the regression bias, we also re-examine the small business job creation hypothesis. Finally we evaluate Davis *et al's* claim (1996a; 1996b) that the current-size measure is an adequate proxy for the adjusted base-month measure in addressing the impact of regression bias.

4.5.1 The magnitude of regression bias

In Table 4.7, the corresponding components of job creation are added together based on the base-month class as well as the components of the average monthly employment change, which are assigned to a particular size class under the adjusted base-month measure. For example, for the smallest size category (less than 5 employees), 15.9 jobs are created per month on average, that is the sum of 9.5 jobs in Class 1 plants, 5.3 in plants which shifted to Class 2 due to employment increase, 0.9 in plants which shifted to Class 3 and 0.2 in plants which shifted to Class 4. Similarly, components of job destruction can be added up as shown in Table 4.8 based on the base month class and the average monthly employment change under the adjusted base month measure.

In these Tables, the boldface entries represent the magnitude of job creation (destruction) associated with regression bias in the base-size measure with respect to small business (less than 100 employees). In the manufacturing sector, for example, the extent of regression bias for small business (less than 100 employees) is estimated to be 148 jobs out of a total of 1754.4 job created by small business.

Table 4.7 Distribution of job creation across different class sizes (1987-2003)

Base[a] \ Adjusted[b]		(1) <5	(2) 5 to 19	(3) 20 to 49	(4) 50 to 99	(5) 100 to 199	(6) 200 to 499	(7) >500
					A. Manufacturing			
(1) <5	38.9	15.9 (40.9)	17.9 (46.0)	3.4 (8.7)	1.7 (4.4)	-	-	-
(2) 5 to 19	192.2	-	136.9 (71.2)	48.2 (25.1)	5.2 (2.7)	**1.9 (1.0)**	-	-
(3) 20 to 49	576.7	-	-	468.5 (81.2)	97.7 (16.9)	**7.4 (1.3)**	**3.1 (0.5)**	-
(4) 50 to 99	946.6	-	-	-	811.2 (85.7)	**130.5 (13.8)**	**3.5 (0.4)**	**1.4 (0.1)**
(5) 100 to 199	1523.0	-	-	-	-	1332.0 (87.5)	189.0 (12.4)	2.0 (0.1)
(6) 200 to 499	2467.0	-	-	-	-	-	2314.0 (93.8)	153.0 (6.2)
(7) >500	3432.0	-	-	-	-	-	-	3432.0
					B. Service			
(1) <5	64.6	22.2 (34.4)	20.8 (32.2)	6.6 (10.2)	15.0 (23.2)	-	-	-
(2) 5 to 19	176.3	-	136.2 (77.3)	34.6 (19.6)	3.0 (1.7)	**2.5 (1.4)**	-	-
(3) 20 to 49	328.5	-	-	277.1 (84.4)	47.3 (14.4)	**3.6 (1.1)**	**0.5 (0.2)**	-
(4) 50 to 99	333.3	-	-	-	291.1 (87.3)	**37.0 (11.1)**	**4.0 (1.2)**	**1.2 (0.4)**
(5) 100 to 199	380.0	-	-	-	-	340.0 (89.5)	39.0 (10.3)	1.0 (0.3)
(6) 200 to 499	664.0	-	-	-	-	-	615.0 (92.6)	49.0 (7.4)
(7) >500	2218.0	-	-	-	-	-	-	2218.0
					C. Construction			
(1) <5	52.7	19.5 (37)	27.1 (51.4)	4.8 (9.1)	1.3 (2.5)	-	-	-
(2) 5 to 19	170.1	-	109.3 (64.3)	50.3 (29.6)	7.2 (4.2)	**3.3 (1.9)**	-	-
(3) 20 to 49	227.4	-	-	164.4 (72.3)	54.0 (23.7)	**8.0 (3.5)**	**1.0 (0.4)**	-
(4) 50 to 99	209.9	-	-	-	154.2 (73.5)	**47.6 (22.7)**	**7.8 (3.7)**	**0.3 (0.1)**
(5) 100 to 199	150.0	-	-	-	-	117.0 (78)	31.0 (20.7)	2.0 (1.3)
(6) 200 to 499	105.0	-	-	-	-	-	94.0 (89.5)	11.0 (10.5)
(7) >500	100.0	-	-	-	-	-	-	100.0

Notes: [a] The Class was classified by the base-month measure. [b] Job creation was assigned by the adjusted base-size measure. Figures in parentheses are the average share of job creation allocated to the old class and new class (es) by adjusted base-size measure. Figures with boldface represent the proportion of job creation associated with regression bias in the base-size measure with respect to small business (less than 100 employees).

Table 4.8 Distribution of job destruction across different class sizes (1987-2003)

Base[a] \ Adjusted[b]		(1) <5	(2) 5 to 19	(3) 20 to 49	(4) 50 to 99	(5) 100 to 199	(6) 200 to 499	(7) >500
					A. Manufacturing			
(1) <5	8.0	8.0	-	-	-	-	-	-
(2) 5 to 19	148.0	3.0 (2)	145.0 (98)	-	-	-	-	-
(3) 20 to 49	607.0	1.0 (0.2)	39.0 (6.4)	567.0 (93.4)	-	-	-	-
(4) 50 to 99	1101.3	0.1 (0.03)	4.8 (0.4)	96.6 (8.3)	999.8 (91.2)	-	-	-
(5) 100 to 199	1793.0	-	**1.0 (0.1)**	**8.0 (0.4)**	**149.0 (8.3)**	1635.0 (91.2)	-	-
(6) 200 to 499	2980.0	-	-	**2.0 (0.1)**	**10.0 (0.3)**	200.0 (6.7)	2768.0 (92.9)	-
(7) >500	3705.0	-	-	-	**0.5(0.01)**	2.0 (0.1)	160.0 (4.3)	3542.5 (95.6)
					B. Service			
(1) <5	19.0	19.0	-	-	-	-	-	-
(2) 5 to 19	173.0	5.0 (2.9)	168 (97.1)	-	-	-	-	-
(3) 20 to 49	335.8	0.5 (0.1)	25.1 (7.5)	310.2 (92.4)	-	-	-	-
(4) 50 to 99	357.6	0.1(0.03)	1.5(0.4)	37.0 (10.3)	319.0 (89.2)	-	-	-
(5) 100 to 199	376.3	-	**1.3 (0.3)**	**1.7 (0.5)**	**35.3 (9.4)**	338.0 (89.8)	-	-
(6) 200 to 499	555.0	-	-	**1 (0.2)**	**2 (0.4)**	26 (4.7)	526 (94.8)	-
(7) >500	1647.7	-	-	-	-	1.5 (0.1)	28 (1.7)	1618.2 (98.2)
					C. Construction			
(1) <5	14.0	14	-	-	-	-	-	-
(2) 5 to 19	131.0	10 (7.6)	121 (92.4)	-	-	-	-	-
(3) 20 to 49	227.1	0.5 (0.2)	33.8 (14.9)	192.8 (84.9)	-	-	-	-
(4) 50 to 99	198.0	-	2.2 (1.1)	36.4 (18.4)	159.4 (80.5)	-	-	-
(5) 100 to 199	178.9	-	**0.3 (0.2)**	**4.2 (2.3)**	**39 (21.8)**	135.4 (75.7)	-	-
(6) 200 to 499	201.0	-	**1 (0.5)**	**4 (2)**	**39 (19.4)**	37 (18.4)	120 (59.7)	-
(7) >500	177.8	-	-	-	-	0.1 (0.1)	10.0 (5.6)	167.7 (94.3)

Notes: [a] The Class was classified by the base-month measure. [b] Job destruction was assigned by the adjusted base-size measure. Figures in parentheses are the average share of job creation allocated to the old class and new class (es) by adjusted base-size measure. Figures with boldface represented the proportion of job destruction associated with regression bias in the base-size measure with respect to small business (less than 100 employees).

4.5.2 Re-examination of small business job creation hypothesis

Table 4.9 summarises the results obtained from the three different methods of calculating average monthly total job creation and destruction per class in the three sectors. The definition of SMEs (< 200 employees in the manufacturing and construction sectors; < 50 employees in the service sector) in Taiwanese Small and Medium Enterprises (SMEA) and the common definition of SMEs among APEC economies (< 100 employees) are used as definitions of small business.

It should be noted that correction for regression bias, using either the current or adjusted base month measures, leaves unchanged or reduces the share of job creation attributable to small business, but potentially increases the share of job destruction associated with small business, because additional job destruction may be assigned to smaller plants[8].

In the construction sector, for example, using the adjusted base-month measure, small business (less than 200 employees) created an average of 769 jobs per month for the period 1987-2003 which is about 76 per cent of all job creation, so that the correction for regression bias brings down the small business share from 80 to 76 percent. On the other hand, small business's job destruction share rises from 66 to 74 per cent when the adjusted base-month measure is used. The changes to small business's job creation and destruction shares due to the adjustment to overcome regression bias in the manufacturing and the service sectors are similar in magnitude to those in the construction sector even when we use the "less than 100 employees" demarcation for small business.

Table 4.9 Average total job creation and destruction per class by different measures in three broad sectors (1987-2003)[a]

	Base-month			Adjusted base-month			Current-month		
	JC	JD	Net JC	JC	JD	Net JC	JC	JD	Net JC
A. Manufacturing									
< 5	39	8	31	16	12	4	14	12	2
5 to 19	192	148	44	155	190	-35	155	184	-29
20 to 49	577	607	-30	520	674	-154	518	671	-153
50 to 99	947	1101	-154	916	1159	-243	916	1162	-246
100 to 199	1523	1793	-270	1472	1837	-365	1468	1845	-377
200 to 499	2467	2980	-513	2510	2928	-418	2518	2941	-423
> 500	3432	3705	-273	3588	3542	46	3588	3527	61
Total	9177	10342	-1165	9177	10342	-1165	9177	10342	-1165
T-SMEs[b]	3278 (36%)	3657 (35%)	-379	3079 (34%)	3872 (37%)	-793	3071 (33%)	3874 (37%)	-803
	# (25%)			# (25%)			# (25%)		
APEC-SMEs[c]	1755 (19%)	1864 (18%)	-109	1607 (18%)	2035 (20%)	-428	1603 (17%)	2029 (20%)	-426
	#(12%)			#(12%)			#(12%)		
B. Service									
< 5	65	19	46	22	25	-3	21	23	-2
5 to 19	176	173	3	157	196	-39	157	190	-33
20 to 49	329	336	-7	318	350	-32	317	350	-33
50 to 99	333	358	-25	357	356	1	347	354	-7
100 to 199	380	376	4	383	366	17	386	368	18
200 to 499	664	555	109	659	554	105	663	560	103
> 500	2218	1648	570	2269	1618	651	2274	1620	654
Total	4165	3465	700	4165	3465	700	4165	3465	700
T-SMEs[b]	570 (14%)	528 (15%)	42	497 (12%)	571 (16%)	-74	495 (12%)	563 (16%)	-68
	# (7%)			# (7%)			# (7%)		
APEC-SMEs[c]	903 (22%)	886 (26%)	17	854 (20%)	927 (27%)	-73	842 (20%)	917 (27%)	-75
	# (12%)			# (12%)			# (12%)		
C. Construction									
< 5	53	14	39	20	25	-5	19	20	-1
5 to 19	170	131	39	136	158	-22	134	154	-20
20 to 49	227	227	0	220	237	-17	216	241	-25
50 to 99	210	198	12	217	237	-20	223	244	-21
100 to 199	150	179	-29	176	173	3	176	178	-2
200 to 499	105	201	-96	133	130	3	144	125	19
> 500	100	178	-78	113	168	-55	103	166	-63
Total	1015	1128	-113	1015	1128	-113	1015	1128	-113
T-SMEs[b]	810 (80%)	749 (66%)	61	769 (76%)	830 (74%)	-61	768 (76%)	837 (74%)	-69
	# (53%)			# (53%)			# (53%)		
APEC-SMEs[c]	660 (65%)	570 (51%)	90	593 (58%)	657 (58%)	-64	592 (5%)	659 (58%)	-67
	# (40%)			# (40%)			# (40%)		

Notes: [a] Job creation (or destruction) share is in parentheses. [b] The average monthly total job creation (or destruction) under the definition of SMEs (Less than 200 employees in manufacturing and construction sectors; less than 50 employees in service sector) in Taiwanese Small and Medium Enterprises (SMEA). [c] The average monthly total job creation (or destruction) share under the definition of SMEs (less than 100 employees) among most APEC economies.

represents small business employment share.

The question to address now is whether these changes to the shares of total job creation and total job destruction for small and large business associated with the correct attribution of employment change to class sizes, influence our conclusions about the job creation (destruction) hypothesis.

The evidence in Table 4.9 shows that accounting for regression bias does not reverse the finding from the base-month measure that small business has a higher job creation share relative to its corresponding employment share and, thus, still support the small business job creation hypothesis. In the construction sector, for example, the job creation share (76 per cent) of small business (less than 200 employees) exceeds its share of the employment base (53 per cent) by 23 percentage points. The superior performance of small business with respect to job creation is also found in the manufacturing (34 per cent share of job creation vs. 25 per cent share of employment) and service sectors (12 per cent vs. 7 per cent).

Moreover, as noted, the correction of the job destruction data by either the current month or adjusted base month measure will tend to increase the small business share of job destruction. Thus correction for regression bias strengthens the claim that small business is disproportionately responsible for job destruction. For example, the job destruction share (74 per cent) of small business (less than 200 employees) in the construction sector exceeds its share of employment (53 per cent).

In summary, despite quite significant adjustments to the job creation shares of small business across the three sectors, resulting from the correction for regression bias, the dataset reveals that small business is disproportionately responsible for job creation (and job destruction) in Taiwan and can be considered more dynamic than large business.

This is consistent with Davidsson *et al.*'s (1998) study based on US data although, as we have noted, they corrected for regression bias by arbitrarily assuming, in the absence of adequate data, that half of the total job creation (destruction) was attributable to the old size class and other half to the new size class.

Turning now to net job creation, it should be noted that only in the services sector was there a net increase in employment over the sample period. Regression bias has a significant impact on small business's net job creation in all sectors. In the construction sector using the base-month measure, small business (less than 200 employees) created 61 net new jobs per month during the period 1987-2003 even though overall employment in the construction sector declined by 113 per month during these 17 years. Thus we could tentatively conclude that small business was the source of employment increase in this sector over the period 1987-2003, even though total employment declined. However, if we adopt the adjusted base-month measure, net job creation of small business changes from the creation of 61 jobs to the destruction of 61 jobs, which represents more than 53 per cent of total job loss. Thus, when employment change is correctly assigned across plant sizes, small business is actually disproportionately responsible for the overall *decline* in employment in the construction sector.

Also if regression bias is taken into consideration, net job creation of small business (< 200 employees) in the manufacturing sector changes from the destruction of 379 jobs to the destruction of 793 jobs, which represents more than 50 per cent of net job loss in the sector. Small business (< 200 employees) represents 25 per cent of total employment. In sum, small business is also disproportionately responsible for the net loss of jobs in the manufacturing sector, irrespective of how small business is defined.

On the other hand, correction for regression bias in the services sector reveals a change from the creation of 42 jobs per month to the destruction of 74 jobs per month, despite a net overall increase in employment of 700 jobs in this sector. Thus small business in the services sector does not disproportionately contribute to net job creation, since it is associated with a net decline in jobs.

Thus, in summary, after correcting for regression bias, we find that, in the declining manufacturing and construction sectors, small business is disproportionately responsible for net job loss as compared to its employment share.

On the other hand, in the service sector, small business, however defined, is responsible for net job loss, yet employment overall in the sector grew. Thus the shift in the size distribution of plants in services favours large business, which, as a consequence, had an increasing share of total employment over the sample period.

Table 4.10 reports the average job flows and employment in 1987 and 2003. As would be expected small business across the three sectors is disproportionately responsible for job creation (and job destruction) in both 1987 and 2003 compared to its employment share and this evidence support the small business job creation hypothesis. In the manufacturing sector, for example, the job creation share (34 per cent) of small business (less than 200 employees) in 1987 exceeds its share of total employment (25 per cent) by 9 percentage points. Moreover, small business is disproportionately associated with job loss over the whole period (as shown in Table 4.9) which means that by the end of the period small business should represent a smaller share of total employment. For example, small business (less than 200 employees) in manufacturing and construction has gone from 25 to 19 per cent and from 58 to 49 per cent of total employment in the corresponding sectors, respectively. Small business employment (less than 50 employees) in the service sector has declined from 9 to 6 per cent of total employment in the sector. This evidence shows a shift to large business in each sector and indicates that the Taiwanese economy is increasingly dominated by large business, however defined.

Table 4.10 Average total job creation and destruction per class 1987 and 2003

	1987	1987	1987	1987	2003	2003	2003	2003
	JC	JD	Net JC	Employment	JC	JD	Net JC	Employment
				A. Manufacturing				
<5	4	8	-4	450	36	20	16	612
5 to 19	135	155	-20	7239	229	273	-44	8297
20 to 49	628	551	77	26837	683	553	130	17700
50 to 99	956	978	-22	54231	1130	1592	-462	34371
100 to 199	830	892	-62	119292	2080	2144	-64	60596
200 to 499	1444	1644	-200	238345	3569	4670	-1101	196315
>500	3158	2211	947	378609	4446	4298	148	338470
Total	7155	6439	716	825003	12173	13550	-1377	656361
T-SMEs	2553 (36%)	2584 (40%)	-31 (-4%)	208049 (25%)	4158 (34%)	4582 (34%)	-424	121576 (19%)
APEC-SMEs	1723 (24%)	1692 (26%)	31 (4%)	88757 (11%)	2078 (17%)	2438 (18%)	-360	60980 (9%)
				B. Service				
<5	175	177	-2	1604	174	180	-6	2570
5 to 19	169	177	-8	10378	169	229	-61	12899
20 to 49	359	334	26	26538	255	324	-69	21533
50 to 99	333	318	16	25625	335	340	-5	29991
100 to 199	373	313	60	29840	393	382	11	35990
200 to 499	567	447	119	49663	750	685	65	76853
>500	1593	761	832	291269	2828	1780	1048	413185
Total	3569	2526	1043	434917	4902	3919	983	593021
T-SMEs	704 (20%)	688 (27%)	16 (2%)	38520 (9%)	597 (12%)	733 (19%)	-137 (-14%)	37002 (6%)
APEC-SMEs	1037 (29%)	1006 (40%)	31 (3%)	64145 (15%)	932 (19%)	1073 (27%)	-141 (-14%)	66993 (11%)
				C. Construction				
<5	173	168	5	522	174	175	-1	797
5 to 19	163	128	35	3698	127	113	14	4290
20 to 49	298	286	12	7718	147	163	-16	5384
50 to 99	311	344	-33	7863	102	120	-18	3761
100 to 199	201	209	-8	5596	78	66	12	3685
200 to 499	111	154	-43	4848	132	73	59	3579
>500	44	63	-19	13763	72	254	-182	15266
Total	1301	1352	-51	44008	832	964	-132	36762
T-SMEs	1146 (88%)	1135 (84%)	11	25397 (58%)	628 (75%)	637 (66%)	-9	17917 (49%)
APEC-SMEs	945 (73%)	926 (68%)	19	19801 (45%)	550 (66%)	571 (59%)	-21	14232 (39%)

Notes: See Table 2.9

4.5.3 Adequacy of current-size measure

By reference to Table 4.9, we now examine whether the current size measure adequately addresses regression bias and hence is a reasonable approximation for the correct method of job assignment. For estimates of job creation and job destruction by small business considered separately, the percentage errors[9], associated with using the current size rather than the adjusted base month measure, are under 2 per cent and generally under 1 per cent. The percentage errors associated with the base month measure are significantly higher, ranging from -13 per cent to 15 per cent.

On the other hand, the errors associated with net job creation using the current size measure are somewhat higher, which is unsurprising given that net job creation has 2 components, which are differenced. The maximum error for net job creation across the sectors and definitions of small business is 13 per cent in the construction sector for small business defined as less than 200 employees[10]. However, again, estimates based on the current size measure are much more accurate than those based on the base month measure, with the latter ranging from -52 per cent to -241 per cent. Also in the example cited above, the base month measure yielded a positive net increase in jobs for small business in the construction sector, whereas the adjusted base month and current size measures both revealed job losses.

Based on the adjusted base-month measures, we conclude that regression bias should be treated with caution since it has a significant impact on the shares of job creation and destruction across the three sectors, as well as net job creation. After correction for regression bias, however, the small business job creation (and destruction) hypotheses continue to be supported across the three sectors. Thus, with respect to job creation and destruction, small business can be considered more dynamic than large business in Taiwan. Also, current-size measures of job creation and job destruction are reasonable approximations for the correct method of assignment because the percentage errors associated with current size measures are relatively small.

The picture is less clear when net job creation is considered. Regression bias is significant and in one instance (construction) the base-month measure yields positive net job creation for small business, whereas the current-size and adjusted base-month measures yield negative net job creation. Further, in the services sector, correct attribution of net job creation yields declining employment for small business, despite growing employment for the sector as a whole. In addition, the current size measure is less accurate for net job creation, so it should be used with some caution, when assessing the contribution of small business to employment change.

Finally, the analysis has shown that, while small business in the three sectors exhibits greater dynamism with respect to job creation and destruction, it is not the source of sustained employment increase. This has important policy implications which are addressed in the final section.

4.6 Conclusion

This Chapter has constructed a number of summary measures of job creation and destruction in the Taiwanese manufacturing, service and construction sectors. We simultaneously employed base size, current size and adjusted base-size measures, which have the distinctive advantage of enabling the adequacy of the current-size measure to be investigated.

There are several significant findings, which have important implications for economic research and policymaking. Taiwanese government policy has targeted small business for preferential treatment which has included subsidies and lower taxes. These policies were established because the public discourse was based on the view that small business being the engine (or dynamic sector) in the Taiwanese economy. To provide some informed insights into this assertion, this Chapter has carefully examined the so-called small business job creation hypothesis. We emphasise that the analysis of this Taiwanese dataset does not yield universally valid propositions about small business.

Section 4.2 shows that previous studies reported results from two different versions of the small business job creation hypothesis, one of which was expressed in terms of a comparison of rates and the other in terms of a comparison of shares. The two versions of the small business job creation hypotheses can be reconciled, as long as we take account of the job creation (net job creation) share relative to its corresponding employment share.

Moreover, most of the research literature focuses on the manufacturing sector and attempts to generalise from that experience (Davis *et al.*, 1996a, 1996b; Borland and Home, 1994; Baldwin and Picot, 1995; Broersma and Gautier, 1997; Tsou *et al.*, 2002). Job creation and destruction behaviour by plant size outside manufacturing are still largely unknown.

Section 4.3 shows that the base-size and current-size measures produce different results for the net job creation rate which is consistent with the results published by Davis *et al.* (1996a, 1996b). These discrepancies suggest that further investigation of the extent of bias in the calculation of gross and net job flows for small business is warranted. We used the adjusted base-size measure to explore the extent of regression bias and the relative efficiency of the current-size measure to correct for regression bias. We discovered that the number of inter-class plants is small which supports the hypothesis advanced by Davidsson *et al.* (1998).

However, a large percentage of job creation and destruction is due to inter-class plants which suggest that the use of the base-size measure may involve significant regression bias. We discovered that in terms of job creation and destruction shares, the extent of regression bias of small business should be treated with caution. Although the small business job creation and destruction hypotheses are not overturned, significant percentage changes in job creation and destruction shares are found in the construction sector. Finally, we found that the current-size measure largely addresses regression bias with respect to job creation and destruction treated separately. This suggests that it is a preferable method of dealing with regression bias given that the process involved in generating adjusted base-size measures is complex and time-consuming. However regression bias with respect to net job creation is significant, and was not always adequately addressed by using the current size measure.

We found support for the small business job creation hypothesis across all three sectors. Thus small business can be viewed as the engine of job creation. However, small business also destroys jobs in disproportionate numbers, which is revealed by the analysis of net job creation. Small business is not the source of sustained increases in employment, which is confirmed by the change in the size distribution of firms across the three sectors over the sample period.

Policy makers should be very cautious about implementing preferential treatment for small business, without being better informed about the reasons for it being disproportionately responsible for job loss. For example, small business faces a lack of financial capital, because of difficulties associated with borrowing from commercial banks due to their inability to provide adequate collateral. Thus if job loss (business failure) results from lack of access of small business to finance then this should be directly addressed – rather than say simply subsidising employment in small business.

Another important dimension of job creation and destruction behaviour is their responsiveness to the business cycle. The cyclical behaviour of job creation and destruction in Taiwan has not been analysed. Thus, the cyclical behaviour of job creation and destruction and their relationship to exogenous shocks (for example, monetary policy) is the subject of the following chapters.

Appendix A: The Size Distribution Fallacy

This appendix uses the example from Davis *et al.* (1996a; 1996b) and explains how the fallacy causes a mistaken interpretation in favour of small business. Assuming the definition of a small business is a firm with less than 500 employees, one can easily calculate the “contribution” of small business:

$$\text{(4.1A)} \qquad \frac{SMALL_{1990} - SMALL_{1989}}{TOTAL_{1990} - TOTAL_{1989}}$$

The relative contribution of small business in 1990 is calculated as the net employment change of small business divided by the total net employment change. The fallacy occurs once firms move across the size categories from one year to the next.

In Table 4.1A one firm migrates between categories. In year 1 Firm 1 is defined as being a small business while Firm 2 and Firm 3 satisfy the definition of large business. During the year, Firm 1 and Firm 2 shrink but Firm 3 grows. Small business employment grows because Firm 2 falls into the category of small business. Then drawing on 4.1A, small business is responsible for 90 percent of net job growth.

Davis *et al.* (1996a; 1996b) suggests that inter-class movement is frequent and important because of the significance of gross job flows. As a result, researchers should avoid the size distribution fallacy from correct assignment of job creation and destruction.

Table 4.1A Explaining the size distribution fallacy

	Firm 1	Firm 2	Firm 3	Small firms	Big firms	All firms
Year 1 employment	300	550	650	300	1200	1500
Year 2 employment	50	340	1210	390	1210	1600
Net change	-250	-210	560	90	10	100
The contribution of small business to net employment change =(390-300)/(1600-1500)=0.9						

Source: Davis *et al.* (1996a, p.62; 1996b, p.303).

Appendix B: Netting out problem

The claims of previous studies, (for example, Birch 1979) that small business creates a disproportionate fraction of net job creation might involve the netting out fallacy. To understand this fallacy, this Appendix draws on one example from Davis *et al.* (1996a, 1996b) to explain how the fallacy might mislead the statistically naive.

In Table 4.2A, Firm 1 and Firm 3 grow while Firm 2 declines in year 1. One can see the small business creates 50 jobs but large business has zero net employment change. Thus one might infer that small business created all the new jobs. However, small business only creates 20 per cent of the new jobs using formula 4.3A. The fallacy arises because net job creation of all firms has neutralised the real job creation.

(4.2A) $$Net\ \ job\ creation\ share = \frac{Net\ \ job\ creation\ of\ \ small\ \ firms}{Net\ \ job\ creation\ of\ \ all\ \ firms}$$

(4.3A) $$Gross\ \ job\ creation\ share = \frac{Net\ \ job\ creation\ of\ \ small\ \ firms}{Gross\ \ job\ creation\ of\ \ all\ \ firms}$$

In conclusion, in order to avoid the fallacy of netting out, researchers should focus on the gross job creation share (formula 4.3A) of small business rather than the net job creation share (formula 4.2A).

Table 4.2A Illustration of netting out

	Firm 1	Firm 2	Firm 3	Small firms	Big firms	All firms
Year 1 employment	300	600	600	300	1200	1500
Year 2 employment	350	400	800	350	1200	1550
Net change	50	-200	200	50	0	50
The net job creation share of small firms=50/50=1						
The gross job creation share of small firms=50/(50+200)=0.2						

Source: Davis *et al.* (1996a, p.64; 1996b, p.304).

Appendix C: The definition of small and medium enterprises (SMEs) across countries

Area	Sectoral definition	Criterion for definition	Micro-sized enterprise	Small-sized enterprise	Medium-sized enterprise
America (SBA)	Manufacturing & Mining	Number of workers		< 500	
	Non-manufacturing	Annual receipts		US$ 5 million	
Australia	Manufacturing	Number of workers		< 100	< 500
	Non-manufacturing	Number of workers		< 20	< 500
Brunei		Number of workers		1 – 20	21 - 100
Canada	Manufacturing	Number of workers		< 100	< 500
	Non-manufacturing	Number of workers		< 50	< 500
European Union	Non-primary	Number of workers	0 – 9	10 – 49	50 - 249
		Annual turnover	EUR 2 million	EUR 10 million	EUR 50 million
		Total balance-sheet	EUR 2 million	EUR 13 million	EUR 43 million
Hong Kong	Manufacturing	Number of workers			< 100
	Non-manufacturing	Number of workers			< 50
Indonesia				< 20	<100
Ireland		Number of workers		< 50	
		Annual revenue		IR$ 3 million.	
Japan	Manufacturing	Number of workers			< 300
		Capital			Yen 300 million
	Wholesale	Number of workers			< 100
		Capital			Yen 100 million
	Retail	Number of workers			< 50
		Capital			Yen 50 million
	Service	Number of workers			< 100
		Capital			Yen 50 million
Korea		Number of workers			< 300
		Capital			US$ 60 million
Mexico		Number of workers	1 – 15	16 – 100	101 - 250
Netherlands		Number of workers			< 100
Taiwan	Manufacturing & Construction	Number of workers		< 20	
	Service	Number of workers		< 5	
	Manufacturing, Construction	Number of workers			20 - 199
		Financial asset			NT$ 80 million.
	Service	Number of workers			5 - 50
		Annual turnover			NT$ 100 million
Singapore	Service & Commerce	Number of workers			< 100
Thailand		Number of workers		< 50	51 - 200
		Capital		Baht 20 million	
Turkey	Manufacturing	Number of workers	1 – 9	10 – 49	50 - 250
		Investment amount	EUR 550000	EUR 550000	EUR 550000

Source: The Profile of SMEs and SME Issues in APEC 1990 - 2000, APEC, 2002.
Small and Medium Enterprise in Turkey: Issues and Policies, OECD, 2004.

Notes:

[1] Davis *et al.* (1996a, 1996b) also argue that previous studies of job creation processes (for example, Birch, 1979) are based on the use of the Dun and Bradstreet Market Identifier (DMI) files). There are two main weaknesses with these data. First, there is an enormous difference between DMI files and the data produced by Bureau of Labor Statistics (BLS) or the Bureau of the Census in America. For example, total employment derived from the DMI database exceeded the figure published by the BLS and census data by 9 million in 1986. In US there were around 110 million employees in 1986 in BLS files. This significant difference may lead to a distortion of the results. Second, the DMI files do not provide correct information about business births and deaths, which would be required if one was to calculate job creation due to firm births and job destruction due to firm deaths.

[2] Baldwin and Picot (1995) propose a previous period current size measure (see Section 3.4). Konings (1995) employs Markov transition matrices, which account for movements in the entire cross-section distribution of plant sizes. Konings (1995) finds that job creation and destruction between different size classes do not lead to convergence, so that there is no regression to the mean. However, Baldwin and Picot (1995) and Konings (1995) do not provide direct evidence with regard to the number of inter-class plants and their impact on job creation and destruction.

[3] The definitions of base-size and current-size measures are introduced in Section 3.3. See also four examples which show the differences between base-size and current-size measures in Section 3.4.

[4] Based on annual dataset for the period 1981-1994, Tsou *et al.* (2002) find that plants with more than 100 employees account for 77 per cent of job creation and 85 per cent of job destruction. Over the whole period 1981-1994, plants with more than 100 employees account for 88 per cent of manufacturing employment.

[5] The average number of plants leaving Class i (i^{th} row sum) does not necessary equal the number of plants joining Class i (i^{th} column sum) because the size distribution of plants is not in a steady state.

[6] By contrast, Davis *et al.* (1996a; 1996b) argue that the number of inter-class movements is significant.

[7] The first step in deriving the adjusted base-size measure is to count the jobs due to plants growing or falling into the next class. The next step is to allocate these jobs to the old class and the new class(es), respectively.

[8] Thus, if calculations using the base month measure reject the job creation hypothesis but support the job destruction hypothesis, correction for regression bias would not change these conclusions.

[9] The percentage error is defined as 100*(current size estimate - adjusted base month estimate)/ adjusted base month estimate.

[10] The current size estimate is a job loss of 69, compared to 61 under the adjusted base month measure.

Chapter 5 Job Creation and Destruction

5.1 Introduction

Research into the behaviour of job flows has burgeoned since 1990. Given the wider availability of suitable datasets, job turnover rates can be calculated for most advanced countries and for many developing countries. This Chapter documents three key features of job creation and destruction based on previous studies which form the stylised facts that benchmark our own study of the Taiwanese labour market.

The first notable feature that is commonly found in studies of gross job flows is that job creation and destruction rates are large relative to net employment change in both advanced and developing economies. In the US, Davis and Haltiwanger (1992) find that about one in ten jobs are created and another one in ten jobs are destroyed each year during the 1973-88 period. Moreover, Ribeiro *et al.* (2004) find that around 16 per cent of jobs are created and 15 per cent of jobs are destroyed each year between 1991 and 2000 in the Brazil, which implies a high gross job creation rate relative to the net job creation rate.[1]

Second, job destruction rates exhibit greater cyclical fluctuations than job creation rates. Although some researchers (Boeri, 1996; Ilmakunnas and Maliranta, 2003) have found contrary evidence, several theoretical models have been developed to explain this cyclical behaviour of job flows (for example, Mortensen, 1994; Mortensen and Pissardes, 1994; Campbell and Fisher, 2000; Mitchell and Muysken, 2003).

Third, the connection between job reallocation and worker turnover varies across countries. Job reallocation counts jobs, while worker turnover counts individuals. Davis and Haltiwanger (1992) find around a third to a half of all worker turnover is due to job reallocation. However, Tsou *et al.* (2002) find only around 17 per cent of worker turnover is caused by job reallocation in Taiwan and suggest the worker turnover is more dynamic in Taiwan than in Western countries. After a review of previous studies, this Chapter explores how job creation and job destruction rates vary across sectors and the dynamics of worker turnover in Taiwan. Finally, the Chapter examines the features of job creation and destruction across regions in Taiwan.

5.2 Gross job flows: International evidence

In this section, we document some key facts with regard to the magnitude of gross job flows in advanced and developing countries. Such comparisons are an interesting aspect of this research area, as they might throw some light on the dynamics of labour markets across countries. However, several measurement problems merit attention.[2] First, the sampling period differs across studies. A number of studies (for example, Garibaldi *et al.*, 1997; Ilmakummas and Maliranta, 2003) show that job flows are highly sensitive to the phases of the business cycle. In other words, meaningful comparisons require that the sample period is long enough so that averaging across business cycles is possible. Second, the unit of observation varies across studies. Davis and Haltiwanger (1996b) point out that establishment-level data are preferred to firm-level data because firm-level data cannot capture the job flows between plants of the same firm.

In order to make the comparisons as meaningful as possible, only establishment level studies of job flows with long sampling periods are selected. Table 5.1 summarises the annual job turnover[3] rates for 19 countries over different time periods. Several results are worth noting. First, job turnover rates vary significantly across countries. In developed countries, notably Canada, France and the US, about one in ten jobs are created and a similar number of jobs are destroyed each year. By contrast, there are higher job turnover rates in the developing economies, such as Brazil and Mexico. A possible explanation is that labour institutions and associated laws, such as employment protection legislation, reduce the job flows in advanced countries as compared to developing countries (Davis and Haltiwanger, 1999a).

Second, Table 5.1 shows the phenomenon of simultaneous job creation and destruction. A useful measure for the coexisting gains and loses of employment across establishments, which introduced by Davis and Haltiwanger (1996b), is defined by taking job reallocation in excess of the absolute value of the net employment change.[4] The excess job reallocation (EX) in sector *s* from period *t*-1 to *t* is denoted as

$$(5.1) \qquad EX_{s,t} = JR_{s,t} - \left|NET_{s,t}\right|$$

Table 5.1 International comparison of annual job flow rates, per cent.[1]

Country	Period	Frequency	Coverage	Employer unit	JC	JD	NET	JR	EX	Source
Australia	1983-2001	Quarterly	All sectors	Establishments	4.3	3.1	1.2	7.4	6.2	Mitchell et al., (2006)
Austria	1978-1998	Annual	All sectors	Establishments	8.9	8.9	0.0	17.8	17.8	Stiglbauer et al. (2003)
Brazil	1991-2000	Annual	All sectors	Establishments	16.0	14.9	1.1	30.9	29.8	Ribeiro et al. (2004)
Canada	1974-1992	Annual	Manufacturing	Establishments	10.9	11.1	-0.2	22.0	21.8	Baldwin et al. (1998)
Chile	1976-1986	Annual	Manufacturing	Establishments	13.0	13.9	-0.9	26.9	26.0	Roberts (1996)
Chile	1980-1999	Annual	Manufacturing	Establishments	16.6	11.9	4.7	28.5	23.8	Haltiwanger et al. (2004)
Colombia	1977-1991	Annual	Manufacturing	Establishments	12.5	12.2	0.3	24.7	24.4	Roberts (1996)
Colombia	1978-1999	Annual	Manufacturing	Establishments	15.9	9.5	6.4	25.4	19.0	Haltiwanger et al. (2004)
Denmark	1983-1989	Annual	Private sector	Establishments	16.0	13.8	2.2	29.8	27.6	OECD (1996)
Denmark	1981-1991	Annual	Manufacturing	Establishments	12.0	11.5	0.5	23.5	23.0	Albak and Sorensen(1998)
Finland	1986-1991	Annual	All employees	Establishments	10.4	12.0	-1.6	22.4	20.8	OECD (1996)
Finland	1988-1996	Annual	Manufacturing	Establishments	12.4	14.0	-1.6	26.4	24.8	Ilmakummas and Maliranta (2003)
Finland	1988-1997	Annual	Business sector	Establishments	15.2	16.9	-1.7	32.1	30.4	Ilmakummas and Maliranta (2003)
France	1984-1992	Annual	Private sector	Establishments	13.9	13.2	0.7	27.1	26.4	OECD (1996)
Germany	1983-1990	Annual	All employees	Establishments	9.0	7.5	1.5	16.5	15.0	OECD (1996)
Germany	1979-1993	Annual	Manufacturing	Establishments	4.5	5.2	-0.7	9.7	9.0	Wager (1995)
Israel	1971-1972	Annual	Manufacturing	Establishments	9.7	8.2	1.5	17.9	16.4	Gronau and Regev (1997)
Japan	1991-1995	Annual	Private sector	Establishments	4.2	3.9	0.3	8.1	7.8	Genda (1998)
Mexico	1994-2000	Annual	Manufacturing	Establishments	20.1	17.4	2.7	37.5	34.8	Haltiwanger et al. (2004)
New Zealand	1987-1992	Annual	Private sector	Establishments	15.7	19.8	-4.1	35.5	31.4	OECD (1996)
Norway	1976-1986	Annual	Manufacturing	Establishments	7.1	8.4	-1.3	15.5	14.2	Klette and Mathiassen (1996)
Sweden	1985-1992	Annual	All employees	Establishments	14.5	14.6	-0.1	29.1	29.0	OECD (1996)
Sweden	1987-1995	Annual	All sectors	Establishments	11.2	12.1	-0.9	23.3	22.4	Persson (1999)
Taiwan	1981-1994	Annual	Manufacturing	Establishments	6.8	5.3	1.5	12.1	10.6	Tsou et al. (2002)
Uruguay	1985-1995	Annual	Manufacturing	Establishments	8.9	5.0	3.9	13.9	10.0	Haltiwanger et al. (2004)
US	1973-1993	Annual	Manufacturing	Establishments	8.8	10.2	-1.4	19.0	17.6	Baldwin et al. (1998)
US	1947-2005	Quarterly	Manufacturing	Establishments	5.7	5.8	-0.1	11.5	11.4	Davis and Haltiwanger (2006)

Note: JC indicates job creation, JD indicates job destruction, Net indicates net employment growth, JR indicates job reallocation, EX indicates excess job reallocation.
[1]The figures for job flows in Mitchell *et al.* (2006) and Davis and Haltiwanger (2006) are based on the quarterly data.

The absolute value of net employment change can be considered as the minimum required level of job reallocation. In contrast, *EX* indicates the extent of simultaneous job creation and destruction within a certain sector.[5] In US, we find an average value of *EX* of 17.6 per cent of employment per year. Relatively high rates of *EX* have also been found in Canada, Mexico, Finland, Denmark and New Zealand. We only report the aggregate figures for job flows in Table 5.1. However, consistently high rates of excess job reallocation have been found across the 450 four-digit manufacturing industries based on the US Standard Industrial Classification (SIC) system (Davis and Haltiwanger, 1996b).[6] The authors also find that, based on the current size measure, excess job reallocation rates decline monotonically with plant size.[7] Thus, a large fraction of employment opportunities change locations, even during years when total employment exhibits little change. Moreover, the high rates of excess job reallocation also indicate that there is a substantial heterogeneity in the direction of employment change among establishments within the same sector (Davis and Haltiwanger, 1996b). In a given year, many establishments expand employment while other establishments in the same sector contract employment. Several theoretical models have been developed to explain heterogeneous behaviour across establishments that will be discussed in the section 5.4.

Third, the majority of research tends to focus exclusively on the manufacturing sector, which has attracted criticism for being ‘manucentric’ (Hamermesh, 2000). This is the consequence of the greater availability of manufacturing sector data. While some useful conclusions can be drawn from a study of the manufacturing sector, it can be misleading to draw inferences for the whole economy, especially as the manufacturing sector continues to shrink relative to the rest of the economy (Acs *et al.*, 1999).[8] The service sector also differs substantially from manufacturing in terms of the nature of demand shocks, and the operation of the product market and labour relations, all of which might impact on the pattern of employment flows (Ilmakummas and Maliranta, 2003). There is a need for further research on the service sector.

Fourth, there are rarely studies of job flows based on quarterly data. The netting out problem is less severe if quarterly, rather than annual, data are used (Mitchell *et al.,* 2006).[9] Using annual data, Baldwin *et al.* (1998) find that the average job creation rate was 8.8 per cent per year while the job destruction rate was 10.2 per cent per year in the manufacturing sector between 1973 and 1993. In contrast, using quarterly data, Davis and Haltiwanger (2006b) find that 5.7 per cent of jobs were created and another 5.8 per cent of jobs were destroyed in the manufacturing sector over a three-month interval during the period 1947-2005. Although representing different sampling periods, these rates of job creation and destruction illustrate the potential netting out problem associated with annual job flow measures, as compared to the corresponding quarterly measures. Netting out will be discussed in the section 5.6.

In summary, job creation and destruction rates are large relative to net employment change in both advanced and developing economies. In addition, the high rate of excess job reallocation points to a large fraction of employment opportunities changing location even during years of nearly constant total employment. Finally, there is a need for further research on the service sector with quarterly data.

5.3 Cyclical behaviour of job flows

The cyclical behaviour of job flows has received increased attention since Davis and Haltiwanger (1992) found that job destruction was countercyclical (that is, negatively correlated with net employment change), and job creation was pro-cyclical. Davis and Haltiwanger (1992) also find that the job reallocation rate was counter-cyclical.

The countercyclical behaviour of job reallocation holds if the job destruction rate varies more than the job creation rate over the business cycle, since Covariance (Job Reallocation, Net Employment Change) = Covariance (Job Creation + Job Destruction, Job Creation – Job Destruction) = Variance (Job Creation) – Variance (Job Destruction).[10] However, the countercyclical nature of job reallocation has been questioned in other research. Boeri (1996) examines the cyclical behaviour of job flows in European countries. Like Davis and Haltiwanger (1992), Boeri (1996) finds that the variance of job destruction rates is larger than the variance of job creation in Norway. However, the evidence for Denmark, France, Germany, Italy and Sweden is mixed with respect to the hypothesis of countercyclical job reallocation (Wager, 1995; Contini *et al.*, 1995; Albak and Sorensen, 1998; Gourinchas, 1999; Persson, 1999).

Ilmarkunnas and Maliranta (2003) explore job and worker flows in the Finnish business sector during the deep global recession in the early 1990s. They find that a countercyclical job reallocation rate occurs in manufacturing, trade, and hotels and restaurants. In other sectors (such as finance, real estate, transport and wholesale and retail trade), job reallocation rate is acyclical or even procyclical. As a result, they find that the evidence for the counter-cyclicality of job reallocation is mixed.

In Taiwan, Tsou *et al.* (2002) find that worker turnover rates are pro-cyclical in the manufacturing sector. They also find that job creation and job destruction rates are negatively correlated. However, the variance of job creation is about one and one-half times larger than the variance of job destruction in the manufacturing sector. Consequently Tsou *et al.* (2002) find that the job reallocation rate in the manufacturing sector was pro-cyclical which implies that the hypothesis of countercyclical job reallocation is not supported for this newly industrialising economy (NIE).[11]

Based on the Survey of Employment and Earnings (SEE), Mitchell *et al.* (2006) classified industry employment into three broad sectors: (a) goods production namely Manufacturing, Construction and Mining); (b) wholesale and retail; and (c) other services.[12] They find that there is no evidence that job creation rates in the service sector have a greater variance than the corresponding job destruction rates in Australia. Furthermore, Mitchell *et al.* (2006) employ regression analysis with a recession dummy and find that job creation is more sensitive to real GDP growth than job destruction. The recession in 1991 had a significant negative effect on job creation in all sectors but only increased job destruction in the goods production and wholesale and retail sectors.

Boeri (1996) suggests that the institutional differences between the US and the Western European labour markets may explain the different cyclical behaviour of job flows. In contrast with the flexibility of the US labour market, European labour markets have tighter dismissal regulations. The high cost of laying off workers may, over time, reduce the average rate of job destruction (and job creation). Thus, a relatively smooth job destruction rate should be observed in the heavily regulated European labour market as compared to the US labour market.

In summary, the evidence of countercyclical behaviour of job reallocation is mixed across countries. Job reallocation in US and Norway is countercyclical. However, it is acyclical or procyclical in other countries (such as Australia, Denmark, France, Italy, Sweden and Taiwan). The different cyclical behaviour of job flows between the US and the Western European may due to the differences associated with dismissal regulations.

5.4 Job Flows: some theoretical explanations

Over the last 18 years, several theoretical models have been developed to explain the behaviour of gross job flows. The purpose of this section is to outline these theories which will help us to better understand the large scale of simultaneous job creation and destruction among establishments whin the same sector. Among recent theories of the magnitude and cyclical sensitivity of job flows, five broad types have received the most attention.

First, Jovanovic (1982) emphasised the role of passive learning in influencing the dynamics of establishment level employment. Establishments are assumed to face uncertainty with respect to the demand for new products or the cost-effectiveness of different technologies, goods and production facilities. Enterprises learn over time and become better able to anticipate their future employment needs, so that the magnitudes of job creation and destruction are reduced. This theory provides an explanation of the negative relationship between the enterprise's age and the magnitude of gross job flows. Despite some empirical support for this theory (for example, Davis and Haltiwanger, 1992; Klette and Mathiassen, 1996), it fails to explain large gross flows among mature plants (Davis and Haltiwanger, 1996b).

Second, the appearance of new, technologically superior establishments is another reason advanced to explain the heterogeneous behaviour of gross job flows (Dunne *et al.*, 1989, Aghion and Howitt, 1992). Caballero and Hammour (1994) suggest that the heterogeneous behaviour results from product and technical innovation, which is a ‘creative destruction’ theory, of the type that was originally proposed by Joseph A. Schumpeter (1942). Schumpeterian economists emphasise that the market is characterised by a continual flow of innovations. As a result, innovative entrepreneurs gain market share and create jobs, while other establishments lose market share and destroy jobs. The creative destruction theory has some empirical support (see, for example, Baldwin *et al.* (1998) in US and Canada, and Greenan and Guellec (2000) in France).

Third, several theories have been developed which incorporate heterogeneity with respect to reallocation friction, such as search cost, hiring cost and firing cost, to explain the magnitude and cyclicality of job flows. Mortensen and Pissarides (1994) suggest that the heterogeneous behaviour across establishments arises from diverse experiences with idiosyncratic shocks. Furthermore, Mortensen and Pissarides (1994) argue that job destruction happens quickly but hiring takes time. Meanwhile, it takes time for job seekers and employers to be matched, reflecting imperfect information. In the model developed by Campbell and Fisher (2000), cost differences induce heterogeneous employment decisions among establishments within a certain sector. Moreover, Campbell and Fisher (2000) argue that the asymmetric variation in job flow rates is caused by profit maximisation behaviour in the presence of proportional job creation and destruction costs. The adjustment costs lead employment at shrinking establishments to respond more quickly to aggregate shocks than employment at growing establishments. Thus, the different marginal costs of job creation and destruction leads to high fluctuations in rates of job destruction and relatively stable job creation rates. The combination of frictions and heterogeneity with respect to costs or idiosyncratic experiences has been found in the empirical analysis of job flows in the US (Mortensen and Pissarides, 1994; Campbell and Fisher, 2000) and Germany (Fahr and Sunde, 2004; 2006).

Fourth, the segmented labour market model assumes that the labour market is characterised by primary and secondary workers because of the heterogenous nature of workers, with respect to skills, experience, competence and preference (Blanchard and Diamond, 1990; Leontaridi, 1998). Primary workers have long job tenures and rarely move into and out of employment. By contrast, secondary workers frequently move between jobs and exhibit instability. In addition, it is reasonable to expect that employers often adjust the number of secondary employees during contractions and expansions, but convert some primary workers to part-time status over the cycle. Mitchell and Muysken (2003) propose a novel segmented labour market model, which characterise primary jobs as full-time and secondary jobs as part-time.[13] Furthermore, they assume that the heterogeneous behaviour of gross job flows results from establishments making different adjustment decisions with respect to full-time and part-time workers. Compared with full-time jobs, establishments face relatively low adjustment costs in creating and filling part-time jobs. As a result, full-time (primary) jobs become part-time (secondary) jobs in a recession, via hours adjustment, in order to meet production requirements. Mitchell and Muysken (2003) find evidence that full-time employment consistently carried the burden of labour market adjustment and part-time employment continues to grow during the 1982 and 1991 recessions in Australia.

The final theory emphasises that the heterogeneity in establishment level employment outcomes arises from allocative disturbances. These are defined as the events that alter the match between the desired and actual distributions of labour and capital inputs (Black, 1982; Davis and Haltiwanger, 1999b). For example, an oil shock decreases the demand for large cars and simultaneously increases the demand for small (fuel-efficient) cars. A positive oil price shock forces automobile companies that produce large cars to reduce employment and capital utilisation. As a result, allocative disturbances stimulate heterogeneous behaviour among establishments and can increase both job creation and destruction. In contrast, an aggregate disturbance causing a transition from expansion to contraction, simultaneously reduces job creation and increases job destruction. Davis and Haltiwanger (1999b) propose the use of structural vector autoregressions (VARs) with long-run neutrality restrictions which imply that the allocative disturbances have no permanent impact on the level of employment. They find that allocative disturbances consistently play a dominant role in driving US job reallocation.

In summary, we have discussed several theories that aim to explain the magnitude and cyclical sensitivity of job flows. Passive learning theory emphasises that enterprises learn over time and become better able to anticipate their future employment needs, which result in a negative relationship between the enterprise's age and the magnitude of gross job flows. Creative destruction theory emphasises that innovative entrepreneurs create jobs and gain market share, causing the simultaneous creation and destruction of jobs across enterprises. The theoretical models of reallocation frictions argue that search cost, hiring cost and the time-consuming matching process cause the job destruction rate to fluctuate more than job creation rates. The segmented labour market model in Mitchell and Muysken (2003) emphasises that establishments making different adjustment decisions with respect to full-time and part-time workers because establishments face relatively low adjustment costs in creating and filling part-time jobs. Finally, Davis and Haltiwanger (1999b) argue that allocative disturbances are the main driving force behind cyclical movements in job reallocation, by stimulating heterogeneous behaviour among establishments and increasing both job creation and destruction. Although different in emphasis, these theories may work together behind large fluctuations of job flows. In particular, job creation is likely to be time consuming for innovative entrepreneurs as they gradually gain market share from their competitors. [14] Meanwhile, job destruction typically occurs immediately when competitors are forced to cut production.

5.5 Job reallocation and worker turnover

Job reallocation counts jobs, while worker turnover counts individuals. Job reallocation is the sum of absolute employment gains and losses, while worker turnover records all worker entries and exits in a given time period. The relationship between job reallocation and worker turnover allows us to quantify worker turnover activity that is demand-driven in the sense of being induced by shifts in the distribution of job opportunities. Note that a meaningful comparison requires a common source of data to calculate job reallocation and worker turnover rates.

Davis and Haltiwanger (1992) use two different data sources, the Longitudinal Research Data file (LRD) and the Current Population Survey (CPS) to calculate job reallocation and worker turnover, respectively. They find that between 32 and 53 percent of worker turnover accommodates shifts in the distribution of employment opportunities. In contrast to Davis and Haltiwanger (1992), Lane *et al.* (1996) compare the magnitudes of job reallocation and worker turnover using a common data source for Maryland in US.[15] Lane *et al.* (1996) find that job reallocation accounts for 44 per cent of worker turnover in manufacturing sector, nearly 28 per cent in the retail trade and 45 per cent in the transportation, communication and utility sectors. Similar results have been found by Boeri (1996) for Germany, Hamermesh *et al.* (1996) for Netherlands and Serrano (1998) for Spain.

Using plant level data, Tsou *et al.* (2002) investigate the cyclical behaviour of job reallocation and worker turnover in the Taiwanese manufacturing sector. They find that only around 17 per cent of worker turnover is caused by job reallocation. This evidence indicates that the majority of observed worker turnover reflects relocation of workers between positions that are neither created nor destroyed. A priori this suggests that the labour market in Taiwan is more dynamic than those in more developed economies. We explore this issue in more detail in Section 5.6. Similar results have been obtained by Roberts (1996) in the three developing countries of Columbia, Chile and Morocco.

5.6 Job and worker flows by sector in Taiwan

In this Section, we initially explore the features of worker turnover and job reallocation from a sectoral perspective. We then investigate the magnitude and cyclical behaviour of gross job flows as well their relationship to worker turnover. The netting out problem is then investigated in the following section.

5.6.1 Worker turnover and job reallocation by sector

This section investigates the basic features of job and worker flows, not only in the manufacturing sector, but also in the service and construction sectors. Table 5.2 represents the average monthly job and worker flow rates from 1987 to 2003.[16] The main finding is that job creation and destruction occur simultaneously. In the manufacturing sector, for example, the monthly job creation rate was 1.69 per cent in 1987, while the corresponding job destruction rate was 1.79 per cent. Moreover, the average job creation and job destruction rates over the period 1987-2003 were 1.21 per cent and 1.36 per cent, respectively. In other words, employment in the manufacturing sector declined at an average rate of 0.15 per cent per month during these seventeen years. Employment in the construction sector had a relatively higher rate of decline (0.39 per cent per month). However, employment in the service sector grew at an average rate of 0.13 per cent per month over the sample period.

Table 5.2a Average monthly job and worker flow rates in the manufacturing sector

Year	Job creation (JC)	Job destruction (JD)	Job reallocation (JR)	Net change (NET)	Hiring (H)	Separation (S)	Worker turnover (T)	Sample size (N)
1987	1.69	1.79	3.48	-0.1	4.17	4.27	8.44	4342
1988	1.52	1.9	3.42	-0.38	3.65	4.03	7.67	4290
1989	1.38	1.92	3.3	-0.53	3.27	3.8	7.07	4164
1990	1.36	1.69	3.05	-0.33	3.09	3.42	6.5	4279
1991	1.27	1.52	2.79	-0.24	2.87	3.11	5.98	4385
1992	1.17	1.58	2.75	-0.42	2.64	3.06	5.71	4388
1993	1.19	1.39	2.58	-0.2	2.59	2.79	5.37	4426
1994	1.22	1.18	2.4	0.04	2.33	2.29	4.62	4246
1995	1.25	1.21	2.46	0.04	2.27	2.23	4.49	3668
1996	1.04	1.11	2.15	-0.07	1.91	1.98	3.9	3273
1997	1.18	0.97	2.14	0.21	2.08	1.88	3.96	3296
1998	0.97	1.09	2.06	-0.12	1.78	1.9	3.68	3294
1999	1.11	1.09	2.2	0.02	1.94	1.92	3.85	3322
2000	1.22	1.06	2.29	0.16	2.19	2.03	4.23	3406
2001	0.72	1.45	2.16	-0.73	1.33	2.06	3.39	3479
2002	1.15	1.08	2.22	0.07	2.05	1.97	4.02	3615
2003	1.14	1.02	2.16	0.12	2.05	1.93	3.98	3738
Mean	1.21	1.36	2.57	-0.15	2.48	2.63	5.11	
Std	0.61	0.49	0.71	0.84	1.16	1.04	2.04	

Source: Survey on Earnings of Employees (SEE), 2006.
Notes: Pearson correlation (JC, JD):-0.2. Pearson correlation (JR, NET):0.2.

Table 5.2b Average monthly job and worker flow rates in the service sector

Year	Job creation (JC)	Job destruction (JD)	Job reallocation (JR)	Net change (NET)	Hiring (H)	Separation (S)	Worker turnover (T)	Sample size (N)
1987	0.71	0.54	1.25	0.17	1.53	1.37	2.9	2989
1988	0.79	0.54	1.33	0.24	1.59	1.35	2.94	3055
1989	0.86	0.54	1.4	0.31	1.62	1.31	2.93	3015
1990	0.76	0.58	1.34	0.19	1.59	1.4	2.98	3063
1991	0.7	0.56	1.26	0.13	1.45	1.31	2.76	3130
1992	0.68	0.59	1.27	0.09	1.47	1.38	2.85	3185
1993	0.74	0.58	1.32	0.16	1.57	1.41	2.98	3225
1994	0.83	0.61	1.44	0.22	1.67	1.46	3.13	3222
1995	0.88	0.63	1.52	0.25	1.86	1.61	3.47	3241
1996	0.72	0.59	1.32	0.13	1.64	1.51	3.15	3193
1997	0.82	0.67	1.49	0.14	1.67	1.53	3.2	3173
1998	0.82	0.81	1.63	0.01	1.73	1.72	3.45	3170
1999	0.74	0.65	1.4	0.09	1.66	1.57	3.22	3166
2000	0.72	0.56	1.28	0.16	1.7	1.54	3.24	3183
2001	0.56	0.68	1.24	-0.11	1.32	1.43	2.75	3190
2002	0.62	0.71	1.33	-0.1	1.47	1.56	3.02	3230
2003	0.78	0.64	1.43	0.14	1.87	1.73	3.59	3803
Mean	0.75	0.62	1.37	0.13	1.61	1.48	3.09	
Std	0.24	0.16	0.24	0.32	0.38	0.25	0.56	

Source: See Table 5.2a.
Notes: Pearson correlation (JC, JD):-0.29. Pearson correlation (JR, NET):0.4.

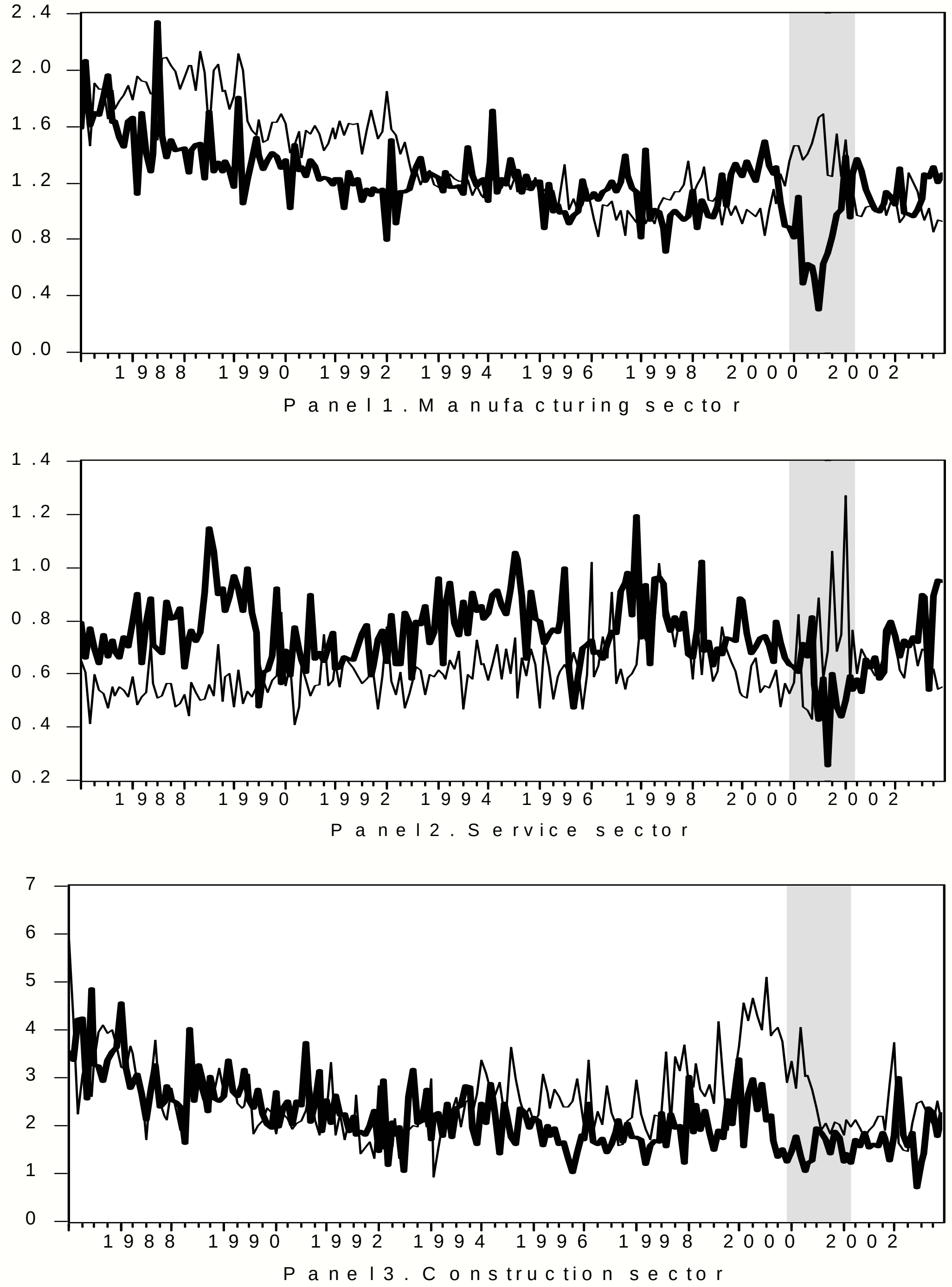
Table 5.2c Average monthly job and worker flow rates in the construction sector

Year	Job creation (JC)	Job destruction (JD)	Job reallocation (JR)	Net change (NET)	Hiring (H)	Separation (S)	Worker turnover (T)	Sample size (N)
1987	3.57	3.71	7.28	-0.15	4.19	4.34	8.54	741
1988	2.92	2.87	5.79	0.05	3.54	3.49	7.04	862
1989	2.68	2.69	5.37	-0.01	3.16	3.17	6.32	947
1990	2.61	2.45	5.06	0.15	3.05	2.9	5.95	961
1991	2.49	2.14	4.63	0.36	2.96	2.6	5.56	965
1992	2.14	1.99	4.12	0.15	2.67	2.51	5.18	975
1993	2.1	1.93	4.03	0.17	2.68	2.51	5.2	969
1994	2.18	2.2	4.39	-0.02	2.75	2.77	5.52	978
1995	2.13	2.76	4.89	-0.63	2.73	3.35	6.08	984
1996	1.69	2.53	4.23	-0.84	2.32	3.16	5.47	926
1997	1.8	2.18	3.97	-0.38	2.37	2.75	5.12	877
1998	1.74	2.61	4.35	-0.87	2.37	3.24	5.61	876
1999	2.13	2.86	4.99	-0.73	2.77	3.5	6.27	865
2000	2.16	4.09	6.25	-1.93	3.01	4.94	7.95	868
2001	1.56	2.61	4.17	-1.04	2.15	3.19	5.34	866
2002	1.55	2.07	3.62	-0.52	2.19	2.64	4.84	865
2003	1.84	2.21	4.05	-0.37	2.52	2.89	5.41	873
Mean	2.19	2.58	4.78	-0.39	2.79	3.17	5.96	
Std	0.53	0.58	0.95	0.58	0.52	0.65	1.02	

Source: See Table 5.2a.
Notes: Pearson correlation (JC, JD):0.08. Pearson correlation (JR, NET):-0.1

Figure 5.1 presents the monthly job creation and job destruction rates for the three sectors over the period 1987 to 2003. There is one interesting result arising from the comparison of the time series properties of these rates. Job creation varies more than job destruction in the manufacturing and service sectors, but reveals the opposite pattern in the construction sector. In the manufacturing sector, for example, the job creation rate has a standard deviation of 0.61 per cent, whereas the standard deviation of the job destruction rate is 0.49 per cent. As a consequence, the job reallocation rate exhibits pro-cyclical behaviour in the manufacturing and service sectors, but is counter-cyclical in the construction sector. The above characteristics of job creation and destruction in the manufacturing sector are consistent with the annual dataset used by Tsou *et al.* (2002) and data from other developing countries (for example, Columbia, Chile, and Morocco) as shown by Roberts (1996), but differ from the results based on research conducted in the US by Davis and Haltiwanger (1992), in Australia by Borland (1996) and in Canada by Baldwin *et al.* (1998). Thus in Taiwan there is limited support for the hypothesis of countercyclical job reallocation, which is based on the behaviour of the construction sector.

Figure 5.1 Time series pattern of job creation and job destruction rates in manufacturing (Panel 1), service (Panel 2) and construction (Panel 3), sa.



Notes: The thick line represents job creation; the thin line represents job destruction. The vertical axis represents the rates of job creation and job destruction (per cent). The shaded area represents the period of recession.

Based on the dating of the Council for Economic Planning and Development (CEPD), the Taiwanese economy endured a deep recession between December 2000 and March 2002. During the recession, job creation and destruction rates in the manufacturing sector dramatically fell and rose, respectively. The service sector exhibited a sharp increase in job destruction accompanied by a relatively mild slowdown in job creation. In contrast, job creation and job destruction rates in the construction sector responded earlier in 2000, prior to the official beginning of the recession. This suggests that the construction sector is a leading indicator of a downturn because Figure 5.1 shows evidence of a forthcoming recession before other sectors. Of interest, however is that jobs were still being lost in 2003 in the construction sector, in contrast to manufacturing. As a consequence, the construction sector may not be a leading indicator of an upturn.

Recall that worker turnover can be separated into two components: (a) job reallocation which is that part of turnover which is due to plants creating and destroying jobs; and (b) the component which is due to ‘voluntary worker turnover’. Voluntary worker turnover includes voluntary quits, which could reflect a range of factors including retirement from the labour force or dissatisfaction with the job match, but also includes a termination initiated by the employer, resulting from dissatisfaction with the match of the employee and the job, which strictly cannot be considered to be voluntary. The issue of termination is discussed further later in the chapter.

In the manufacturing sector, the share of worker turnover due to job reallocation varies between 41 per cent and 64 per cent over the sample period with an average of 52 per cent. The corresponding share is around 40 per cent to 48 per cent in the service sector (average 44 per cent), which is slightly lower than in the manufacturing sector. In contrast, the component of 'involuntary worker turnover' in the construction sector varies between 75 per cent and 85 per cent, with an average of 80 per cent. These results suggest that worker turnover in the service sector is more dynamic than that in the manufacturing and construction sectors in the sense that a larger share is associated with voluntary job switching or a change in employment status, albeit with the inclusion of terminations initiated by the employer due to concerns about the job match. Moreover, the service sector is the only one that exhibits net employment growth over the period which could contribute to the explanation of its dynamism.

Using an annual dataset, Tsou *et al.* (2002) find the average share of worker turnover due to job reallocation in the manufacturing sector is around 17 per cent. By contrast using our monthly data, the share of 'involuntary worker turnover' is about three times that in Tsou *et al.* (2002) which can be attributed to the 'netting out' which occurs when annual data are used (see below). Using quarterly data, Davis and Haltiwanger (1992) find that the job reallocation is around one-third to one-half of worker turnover in the US. Using annual data, similar figures to those generated by Davis and Haltiwanger (1992) have been found by Boeri (1996) for Germany, Hamermesh *et al.* (1996) for Netherlands, and Serrano (1998) for Spain.

5.6.2 The netting out problem

Most previous studies explore job and worker flows based on an annual dataset (see Table 5.1). This section aims to shed some light on the 'netting out' problem caused by the use of annual data. Recall the definition of job reallocation (JR) as the sum of the job creation (positive net changes) and job destruction (negative net changes). Employee turnover (T) is denoted as the sum of the worker entries and exits. Job reallocation counts jobs, while worker turnover counts individuals.

The netting out problem occurs with respect to jobs, but not individuals. Table 5.3 provides an example to illustrate this point. Plant A, for example, with 110 employees, hires 35 and layoffs 5 employees in June. Furthermore, Plant A layoffs 5 employees on December. Using the monthly measure, the overall worker turnover and job reallocation for Plant A aggregated over the twelve months is 45 and 35, respectively. In contrast, using the annual measure, the worker turnover over the one year is 45 and job reallocation is 25. Note that there would be no 'netting out', if a plant grew or stayed constant (or declined/stayed constant) every month of each year.

Table 5.3 Netting out problem in job flows and worker turnover

Plant A	Employment	Worker Turnover	Job flows
January	110		
June	140	35 (H); 5 (S)	30 (JC)
December	135	5 (S)	5 (JD)
Aggregate monthly flows[a]		45 (T) = 35 (H) + 10 (S)	35 (JR) = 30 (JC) + 5 (JD)
Annual flows		45 (T) = 35 (H) + 10 (S)	25 (JR) = 25 (JC) + 0 (JD)

Note: [a]'Aggregate monthly flows' means the monthly flows aggregated over 12 months

If there was no job creation and job destruction occurring in different months in a plant over a year, the annual job creation and destruction rates would be approximately 12 times the average monthly rate.[17] Once there are some months of job destruction, as well as job creation in other months, but the same net employment increase over the year, the average monthly job creation rate multiplied by twelve will be larger than the annual job creation rate (based on annual data), because the annual rate measures the net change over the year.

Ideally the comparison should be between annual and monthly rates based on the same database, which would provide an indication of the degree of netting out. Given the nature of the data collected by the Survey on Earnings of Employees (SEE), we cannot measure the net employment change for each plant over 12 consecutive months which would incorporate any netting out that took place. In contrast, Labour Turnover Surveys (LTS) employed in Tsou *et al.* (2002) has year to year employment changes for each plant which is the basis for calculating the average annual rates of the job creation and destruction which incorporates netting out. Since the form of sampling selection is the same between the Labour Turnover Surveys (LTS) employed in Tsou *et al.* (2002) and the Survey on Earnings of Employees (SEE) used in the present thesis, the only possible way of measuring the extent of netting out is to compare the SEE monthly rates with the LTS annual rates which are based on genuine annual data.

Comparing the SEE monthly rates and LTS annual rates for the same calendar years, that is 1987-1994 (see Tables 5.4 and Table 5.5), we find one interesting feature. The average SEE monthly job creation (destruction) rate multiplied by twelve is significantly larger than the corresponding LTS annual job creation (destruction) rate, which points to the presence of significant netting out. In contrast, the worker turnover rate in LTS is around twelve times that in SEE. The possible explanation of netting out is that the labour market is characterised by primary and secondary workers (Blanchard and Diamond, 1990). Secondary workers frequently leave their positions, the employer then find (or recall) other employees to fill these vacancies.[18] Job instability leads to the average duration of employment in a particular job for an individual being short which occurs because of either a worker or firm initiated separation.[19]

Table 5.4 SEE monthly rates of job and worker flows in the manufacturing sector

Year	Job creation (JC)	Job destruction (JD)	Job reallocation (JR)	Net change (NET)	Hiring (H)	Separation (S)	Worker turnover (T)
1987	1.69	1.79	3.48	-0.10	4.17	4.27	8.44
1988	1.52	1.90	3.42	-0.38	3.65	4.03	7.67
1989	1.38	1.92	3.30	-0.53	3.27	3.80	7.07
1990	1.36	1.69	3.05	-0.33	3.09	3.42	6.50
1991	1.27	1.52	2.79	-0.24	2.87	3.11	5.98
1992	1.17	1.58	2.75	-0.42	2.64	3.06	5.71
1993	1.19	1.39	2.58	-0.20	2.59	2.79	5.37
1994	1.22	1.18	2.40	0.04	2.33	2.29	4.62
Mean	1.35	1.62	2.97	-0.27	3.08	3.35	6.42
Std	0.81	0.55	0.81	1.12	1.37	1.08	2.19

Table 5.5 LTS annual rates of job and worker flows in the manufacturing sector

Year	Job creation (JC)	Job destruction (JD)	Job reallocation (JR)	Net change (NET)	Hiring (H)	Separation (S)	Worker turnover (T)
1987	7.80	4.30	12.10	3.60	47.30	43.80	91.10
1988	7.10	5.30	12.50	1.80	43.10	41.30	84.40
1989	5.90	6.30	12.20	-0.40	39.20	39.60	78.80
1991	6.20	5.30	11.50	1.00	32.00	31.00	63.10
1992	4.80	6.10	11.00	-1.30	29.30	30.50	59.80
1993	5.20	4.60	9.80	0.70	27.80	27.10	55.00
1994	5.30	3.70	8.90	1.60	25.60	24.00	49.60
Mean	6.04	5.09	11.14	1.00	34.90	33.90	68.83
Std	1.08	0.95	1.35	1.59	8.33	7.63	15.88

Source: Tsou *et al.* (2002, p. 406)

In general, lay offs are relatively infrequent, so that the worker is terminated from the employer and there is no expectation that she/he will be recalled to take up the position again. However, recall the definition of gross job destruction (JD) as the sum of the absolute values of negative net changes in employment (see Chapter 3). In other words, when employees voluntarily (or involuntarily) leave their positions in March and employer cannot find another person to fill this position in April, this event represents the destruction of one job even though this event could be initiated by the employee rather than the employer.

In sum, the job reallocation rate based on annual data is relatively low, compared to the annualised figure based on aggregated monthly data, which is not subject to the netting out problem. Furthermore, worker turnover whether defined by month and aggregated up or defined over the year picks up all the changes in the occupants of jobs. If one employee is doing a particular job in August and is replaced by another employee before the end of that month, the quit/sacking and the new hire are identified in the calculations. The share of worker turnover caused by job reallocation will typically be disproportionately lower when annual data are used due to netting out. As a result, claims by Tsou *et al.* (2002) that the labour market is more dynamic in Taiwan than western economies due to a low share of worker turnover being attributable to job reallocation need to be reconsidered.

5.7 Job entry and exit

Understanding the behaviour of workers is fundamental to understanding the operation of the labour market. This section provides some evidence with regard to the entry into employment and exit from employment of workers (as opposed to entry (exit) from the labour force). Worker entry into employment is divided into three components: new hires, recalls and other-entries. Other-entries are measured as the sum of employees coming from other plants and employees who have completed military service and returned to work. Further, worker exit from employment is divided into quits, layoffs and other-exits. Other-exits are measured as the sum of employees who retrained, retired, died, suffered illness or transferred to other plants of the same firm. All measures are converted to annual rates.

Table 5.6 Annual worker flow rates (average 1987-2003, %) by sector

Sector	Hiring	Recall	Other-entry	Total-entry	Quits	Layoffs	Other-exit	Total-exit
Manufacturing	28.34	0.54	0.93	29.81	28.45	1.09	2.02	31.56
Service	18.09	0.57	0.72	19.38	15.15	0.89	1.73	17.77
Construction	24.16	5.73	3.56	33.45	24.15	4.69	8.90	38.10

Table 5.6 shows the rates of entry (new hires, recalls, and other-entries) and exit (quits, layoffs, and other-exits) in the three sectors: manufacturing, service and construction. It is apparent that hiring is the main contributor to worker entry, while quits most strongly contribute to worker exit, which is unsurprising. In the manufacturing sector, for example, 95 percent of total-entries is due to hiring, and quits, both voluntary and involuntary, account for 90 percent of total-exits. Moreover, the entry and exit rates vary by sector. Although the manufacturing sector has higher hiring and quit rates, the construction sector shows higher total-entry and total-exit rates.

Table 5.7 Annual worker flow rates (average 1987-2003, %) by employment growth

Employment Growth	Hiring	Recall	Other-entry	Total-entry	Quits	Layoffs	Other-exit	Total-exit
Declining Plant	10.85	0.30	0.29	11.44	33.53	2.00	3.77	39.30
Constant plant	6.49	0.17	0.21	6.87	6.37	0.14	0.36	6.86
Growing plant	48.22	1.50	1.96	51.69	17.04	0.41	0.68	18.13

Table 5.7 documents percentage worker flow rates in terms of declining, constant[20] and growing plants. Hiring rates are highest in growing plants, but the hiring rate is higher in declining as opposed to plants with constant employment. The high rate of quits in declining plants must be attributable to employer induced quits. The higher rate of worker exit from declining plants leads to a higher hiring rate in these plants than in plants with constant employment. Similar results are found when we further explore employment growth in the three sectors (see Table 5.8).

Table 5.8 Annual worker flow rates (average 1987-2003, %) by employment growth in three broad sectors

Employment Growth	Hiring	Recall	Other-entry	Total-entry	Quits	Layoffs	Other-exit	Total-exit
A. Manufacturing								
Declining plant	12.44	0.26	0.30	12.99	40.74	2.02	3.62	46.37
Constant plant	7.50	0.16	0.23	7.89	7.40	0.12	0.37	7.89
Growing Plant	55.55	1.05	1.97	58.56	19.84	0.22	0.59	20.65
B. Service								
Declining plant	7.97	0.33	0.28	8.57	20.11	1.32	2.94	24.37
Constant plant	5.91	0.15	0.18	6.24	5.76	0.15	0.33	6.24
Growing Plant	35.08	1.02	1.46	37.56	12.75	0.64	0.77	14.15
C. Construction								
Declining plant	5.81	0.48	0.53	6.82	28.27	2.84	20.54	51.65
Constant plant	2.86	0.41	0.22	3.49	2.79	0.21	0.43	3.43
Growing Plant	41.42	12.85	2.85	57.12	10.15	0.68	1.45	12.28

In general, quits should be voluntary separations initiated by employees. Unfortunately, it would appear that the quit figures include both these voluntary separations and also involuntary separations initiated by employersit. However, this is empirically a ‘grey area’ because we cannot infer whether a separation is initiated by employees or employers[21] (Hassink, 2000). For example, the employer can influence resignations by informing workers of the likelihood of being sacked and advising them to seek other employment. The possibility that employers make use of quits for job destruction has been noticed in the literature on job turnover (Davis *et al.*, 1996b) but is not easily measured. Based on the US Current Population Survey (CPS) between 1968 and 1986, Blanchard and Diamond (1990) find that around 9-13 per cent of workers who resigned in the manufacturing sector knew a priori that their jobs would be terminated. Furthermore, Hassink and Broersma (2003) employ panel data of 128 firms in the Netherlands (1988, 1990 and 1992) and find that about 22 per cent of the jobs of workers who resigned were destroyed. As a result, it is reasonable to expect that the figures for quits shown in Tables 5.6, 5.7 and 5.8 include both employee and employer initiated separations.[22]

Table 5.9 provides information about the reasons for job changing during 2003 and 2006. Interviewees who previously had a job were classified as employees, employers or unpaid family workers. Employees were differentiated according to whether they changed jobs voluntarily or involuntarily.

Table 5.9 Job changers by reasons, 2003-2006 (‘000s).

	2003	2004	2005	2006
Total	646	590	600	602
A. Employee	595	549	559	563
1. Voluntary left[1]	450	420	439	448
Low pay	107	116	110	110
Expect to change working place[2]	114	113	114	133
Inadequate working time[3]	38	34	42	43
No job security[4]	46	45	48	40
Poor working environment	56	51	48	49
Knowledge did not meet the job's requirements[5]	14	11	10	11
Limited prospects[6]	27	18	23	14
Ill health	11	6	11	9
Female employee getting married or giving birth	4	3	5	3
Voluntarily retired[7]	5	2	3	5
Establish self own business/enterprise	28	21	25	31
2. Involuntary left[8]	145	129	120	115
Workplace shutdown or business downsize[9]	96	76	65	64
Seasonal or temporary job completed	25	33	30	23
Layoffs	8	9	9	16
Relocated across workplaces but within firm	15	10	14	11
Mandatory retirement[10]	1	1	2	1
B. Employer	38	32	35	31
C. Unpaid family worker	13	9	6	8

Source: Manpower Utilisation Survey

[1] ‘Voluntary left’ means that the interviewee quit the job at his/her own will.

[2] ‘Expect to change working place’ means the working place of the interviewee’s last job was too remote or inconvenient for commuting.

[3] ‘Inadequate working time’ means long working time or no flexibility in working schedule.

[4] ‘No job security’ means an employee in the private sector or a temporary employee in the public sector believed that she/she could be laid of at any time because of employers’ prejudice/preference or a downturn of the business cycle.

[5] ‘Knowledge did not meet the job’s requirements’ means that the knowledge or skill of the interviewee did not meet the requirements of last job.

[6] ‘Limited prospects’ means that were few opportunities for the interviewee to be promoted to a higher position.

[7] ‘Voluntarily retired’ means that before the stipulated age limit, the interviewee retired at his/her own will.

[8] ‘Involuntary left’ means interviewee unwillingly left his/her last job.

[9] ‘Workplace shutdown or business downsize’ means the interviewee had to quit the job because employer stopped operating the workplace or downsized the business.

[10] ‘Mandatorily retirement’ means interviewee’s age reached the limit stipulated by the enterprise’s regulation and he/she had to retire.

Table 5.9 reveals first that most job changers left their last job voluntarily. In 2003, for example, 76 percent of employees who changed jobs left their previous position voluntarily. These data confirm the finding in Tables 5.6 and 5.7 that quits most strongly contribute to worker exits. Moreover, the main reasons for employees quitting their jobs are low pay and the workplace being too remote or inconvenient to commute. In 2003, for example, 19 per cent of employees who changed jobs decided to leave their position because they expected to change workplaces (as defined below) and another 18 per cent of employees were dissatisfied with their previous wage. Finally, the largest share of those who left jobs involuntarily was due to workplace closure or the business being downsized. In 2003, for example, 66 per cent of involuntary quits resulted from workplace shutdown or downsizing. In contrast, layoffs play little role in involuntary exits. Evidently employers have some influence on employees' quit behaviour, with involuntary quits representing about 20 per cent of all quits. If figures for quits by reason were available for growing and declining plants, then the latter would probably reveal a higher rate of involuntary quits.

This section has analysed worker turnover in Taiwan. We found that worker entry mainly consists of new hires and worker exit is dominated by quits, and that this is consistent by sector and net employment change. In addition, the main reasons for job changers quitting their jobs are low pay and the expectation of workplace closure or business downsizing. Unfortunately, given the data limitations we were unable to explain the relatively high rate of quits in declining plants.

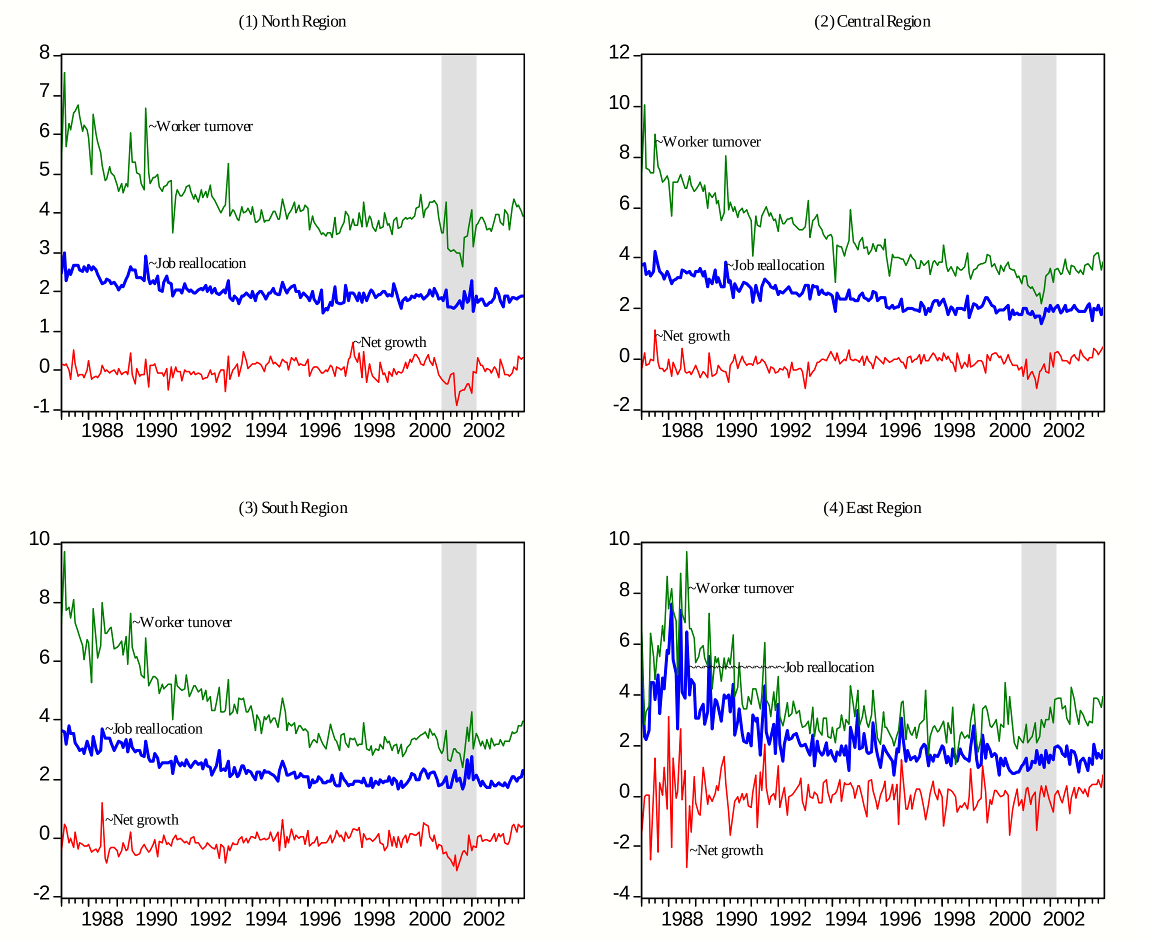
5.8 Job and worker flows by region in Taiwan

The purpose of this Section is to explore the patterns of net employment change (that is the net job creation rate), as well as job creation and job destruction rates across the North, Central, South, and East regions of Taiwan (see Appendix and Figure A1 for an explanation of the location of these four regions).

Tables 5.10a –5.10d present the average monthly job and worker flow rates for the four regions. In order to show a clear picture regard to the job flow across regions, we also present the cyclical behavior of job and worker flow rates for the four regions in Figure 5.2. There are two main findings. First, net employment growth over the seventeen years in Taiwan was concentrated in the North and East regions with average net job creation rates of about 0.015 per cent and 0.019 per cent in the two regions, compared to -0.152 per cent and -0.130 per cent in the Central and South regions, respectively. Each Region is characterised by a different industrial structure. Growing sectors, such as Wholesale, Manufacturing and Finance, are concentrated in the North Region. The growing Tourism sector is now leading the development of the East Region (Kuo, 2005). By contrast, the declining light and heavy industries are concentrated in the Central and South regions, respectively (Hus and Cheng, 2002).

Second, in the North Region the average share of worker turnover associated with job reallocation was 48 per cent, while it was 53, 55 and 61 percent in the Central, South and East regions, respectively. This suggests that the relatively fast growing North Region would be more dynamic than the other three regions because a lower proportion of its ‘worker turnover’ is associated with job reallocation. In other words, the majority of worker turnover reflects rotations of positions that are neither created or destroyed, so that job creation and job destruction occurred in the same month, as illustrated in Table 5.3.[23] Thus the low share of worker turnover associated with job reallocation in the North Region signifies that good information networks lead vacant positions to be filled relatively quickly (within the month) and causes a low level of job reallocation relative to a given level of turnover, since job creation and destruction in the same month cancel each other out.[24] The apparent dynamism identified by Tsou *et al* (2002), namely the 17 per cent share of worker turnover associated with job reallocation, merely indicates that within establishments a significant amount of job creation and destruction was occurring in the same year, and hence was not counted in the figure for job reallocation.

Figure 5.2 The cyclical behavior of regional job flows and worker turnover, sa.



Notes: The shaded area represents the period of recession.

Table 5.10a Monthly job and worker flow rates[a] in the North Region 1987-2003

Year	Job creation (JC)	Job destruction (JD)	Net change (NET)	Job reallocation (JR)	Hiring (H)	Separation (S)	Worker turnover (T)	Sample Size (N)
1987	1.310	1.274	0.036	2.584	3.179	3.143	6.322	3868
1988	1.178	1.219	-0.041	2.397	2.682	2.723	5.405	3754
1989	1.146	1.195	-0.050	2.341	2.449	2.498	4.947	3690
1990	1.129	1.175	-0.046	2.304	2.447	2.493	4.940	3869
1991	1.002	1.048	-0.046	2.050	2.211	2.257	4.467	3940
1992	0.966	1.069	-0.103	2.035	2.127	2.230	4.356	4013
1993	0.988	0.915	0.073	1.903	2.102	2.028	4.130	3988
1994	1.060	0.890	0.170	1.951	2.045	1.874	3.919	3908
1995	1.112	0.921	0.191	2.033	2.141	1.950	4.091	3657
1996	0.898	0.855	0.043	1.752	1.836	1.792	3.628	3418
1997	1.035	0.847	0.188	1.881	1.975	1.787	3.762	3439
1998	0.929	1.000	-0.071	1.929	1.859	1.929	3.788	3523
1999	0.965	0.897	0.067	1.862	1.927	1.860	3.786	3578
2000	1.044	0.868	0.176	1.912	2.148	1.973	4.121	3575
2001	0.667	1.072	-0.405	1.739	1.429	1.834	3.263	3625
2002	0.913	0.911	0.002	1.823	1.867	1.863	3.730	3796
2003	0.952	0.881	0.071	1.833	2.034	1.963	3.998	4217
Mean	1.017	1.002	0.015	2.019	2.144	2.129	4.274	3756
Std	0.39	0.28	0.54	0.42	0.388	0.382	0.757	

Note: [a] Job and worker flow rates averaged over 12 months each year.
Pearson correlation (JC, JD):-0.26. Pearson correlation (JR, NET):0.32.

Table 5.10b Monthly job and worker flow rates[a] in the Central Region 1987-2003

Year	Job creation (JC)	Job destruction (JD)	Net change (NET)	Job reallocation (JR)	Hiring (H)	Separation (S)	Worker turnover (T)	Sample Size (N)
1987	1.726	1.817	-0.090	3.543	3.806	3.896	7.702	1803
1988	1.475	1.828	-0.353	3.303	3.265	3.618	6.883	1873
1989	1.395	1.857	-0.462	3.252	3.000	3.463	6.463	1811
1990	1.366	1.600	-0.234	2.966	2.910	3.144	6.054	1800
1991	1.298	1.516	-0.218	2.814	2.640	2.858	5.498	1852
1992	1.122	1.527	-0.404	2.649	2.476	2.880	5.356	1821
1993	1.244	1.473	-0.229	2.717	2.515	2.744	5.259	1873
1994	1.210	1.183	0.027	2.392	2.265	2.238	4.504	1835
1995	1.207	1.274	-0.067	2.482	2.213	2.280	4.493	1684
1996	1.010	1.061	-0.051	2.072	1.945	1.996	3.941	1571
1997	1.060	1.012	0.047	2.072	1.907	1.860	3.768	1548
1998	0.988	1.084	-0.096	2.071	1.813	1.909	3.723	1512
1999	1.030	1.088	-0.057	2.118	1.825	1.882	3.707	1488
2000	0.901	0.985	-0.084	1.886	1.706	1.790	3.497	1522
2001	0.629	1.173	-0.544	1.802	1.169	1.713	2.882	1547
2002	1.018	0.979	0.039	1.997	1.784	1.744	3.527	1583
2003	1.073	0.872	0.201	1.945	1.979	1.778	3.757	1712
Mean	1.162	1.313	-0.152	2.475	2.307	2.458	4.765	1696
Std	0.58	0.48	0.76	0.73	0.732	0.662	1.381	

Note: [a] Job and worker flow rates averaged over 12 months each year.
Pearson correlation (JC, JD):-0.04. Pearson correlation (JR, NET):0.19.

Table 5.10c Monthly job and worker flow rates[a] in the South Region 1987-2003

Year	Job creation (JC)	Job destruction (JD)	Net change (NET)	Job reallocation (JR)	Hiring (H)	Separation (S)	Worker turnover (T)	Sample Size (N)
1987	1.606	1.708	-0.101	3.314	3.633	3.734	7.366	2085
1988	1.445	1.746	-0.301	3.191	3.248	3.548	6.796	2234
1989	1.346	1.746	-0.400	3.093	2.979	3.379	6.357	2260
1990	1.213	1.464	-0.251	2.677	2.568	2.819	5.388	2256
1991	1.218	1.301	-0.083	2.519	2.482	2.564	5.046	2287
1992	1.070	1.379	-0.309	2.449	2.178	2.487	4.665	2292
1993	1.037	1.244	-0.207	2.281	2.152	2.359	4.511	2329
1994	1.083	1.058	0.025	2.140	2.001	1.976	3.977	2285
1995	1.095	1.102	-0.008	2.197	1.953	1.961	3.914	2169
1996	0.917	1.022	-0.105	1.939	1.629	1.734	3.364	2044
1997	1.012	0.864	0.147	1.876	1.713	1.566	3.280	2022
1998	0.886	1.003	-0.117	1.888	1.518	1.635	3.152	1991
1999	0.950	0.975	-0.024	1.925	1.538	1.562	3.100	1980
2000	1.065	1.023	0.042	2.088	1.721	1.679	3.400	2035
2001	0.695	1.299	-0.604	1.995	1.194	1.798	2.992	2032
2002	0.918	1.013	-0.095	1.931	1.607	1.699	3.306	2011
2003	1.069	0.885	0.184	1.954	1.838	1.655	3.493	2141
Mean	1.096	1.225	-0.130	2.321	2.115	2.245	4.359	2144
Std	0.49	0.41	0.65	0.64	0.732	0.668	1.388	

Note: [a] Job and worker flow rates averaged over 12 months each year.
Pearson correlation (JC, JD):-0.01. Pearson correlation (JR, NET):0.18.

Table 5.10d Monthly job and worker flow rates[a] in the East Region 1987-2003

Year	Job creation (JC)	Job destruction (JD)	Net change (NET)	Job reallocation (JR)	Hiring (H)	Separation (S)	Worker turnover (T)	Sample Size (N)
1987	1.841	2.137	-0.296	3.978	2.607	2.903	5.510	317
1988	2.631	2.447	0.184	5.078	3.708	3.524	7.232	347
1989	1.797	1.670	0.127	3.466	2.790	2.663	5.454	366
1990	1.506	1.632	-0.126	3.138	2.260	2.386	4.646	377
1991	1.409	1.206	0.203	2.615	2.100	1.897	3.997	371
1992	1.204	1.066	0.138	2.270	1.741	1.602	3.343	364
1993	0.932	0.894	0.038	1.827	1.399	1.361	2.761	363
1994	1.100	0.832	0.269	1.932	1.682	1.413	3.095	348
1995	0.969	0.921	0.048	1.890	1.506	1.458	2.963	336
1996	0.842	0.853	-0.011	1.695	1.312	1.324	2.636	331
1997	0.798	0.812	-0.015	1.610	1.338	1.352	2.690	318
1998	0.659	0.932	-0.273	1.591	1.074	1.347	2.421	309
1999	0.856	0.873	-0.017	1.729	1.394	1.411	2.805	304
2000	0.487	0.651	-0.164	1.138	1.300	1.463	2.763	307
2001	0.649	0.725	-0.076	1.373	1.245	1.321	2.566	311
2002	0.814	0.886	-0.072	1.700	1.730	1.790	3.520	296
2003	0.910	0.548	0.362	1.458	1.852	1.490	3.341	296
Mean	1.141	1.123	0.019	2.264	1.826	1.806	3.632	333
Std	0.79	0.73	0.84	1.27	0.686	0.662	1.336	

Note: [a] Job and worker flow rates averaged over 12 months each year.
Pearson correlation (JC, JD):0.39. Pearson correlation (JR, NET):0.08.

Table 5.11 Monthly job and worker flow rates[a] in main cities and counties 1987-2003

Region		Job creation (JC)	Job destruction (JD)	Net change (NET)	Job reallocation (JR)	Hiring (H)	Separation (S)	Worker turnover (T)	Sample Size (N)
North Region	Taipei City	0.745	0.656	0.089	1.401	1.613	1.524	3.137	1395
	Keelung City	0.787	1.025	-0.238	1.813	1.637	1.875	3.512	121
	Hsinchu City	1.595	1.138	0.457	2.733	2.903	2.446	5.349	230
	Taipei County	1.315	1.541	-0.226	2.857	2.676	2.902	5.578	1091
	Taoyuan County	1.309	1.353	-0.045	2.662	2.887	2.932	5.819	754
	Hsinchu County	1.118	1.241	-0.123	2.359	2.321	2.443	4.764	164
Central Region	Taichung City	1.050	1.129	-0.079	2.178	2.251	2.330	4.581	340
	Miaoli County	1.039	1.280	-0.241	2.319	1.945	2.185	4.130	166
	Taichung County	1.340	1.518	-0.178	2.858	2.534	2.712	5.245	556
	Changhua County	1.020	1.181	-0.161	2.201	2.167	2.329	4.496	385
	Nantou County	1.451	1.598	-0.147	3.049	2.594	2.741	5.335	116
	Yunlin County	1.184	1.257	-0.073	2.440	2.332	2.405	4.738	133
South Region	Kaohsiung City	0.999	1.143	-0.144	2.142	2.088	2.232	4.320	776
	Tainan City	1.296	1.453	-0.156	2.749	2.463	2.619	5.082	227
	Chiayi City	1.217	1.337	-0.119	2.554	2.125	2.245	4.370	82
	Chiayi County	1.491	1.617	-0.126	3.108	2.264	2.391	4.655	115
	Tainan County	1.105	1.183	-0.078	2.288	2.065	2.143	4.208	400
	Kaohsiung County	1.021	1.127	-0.106	2.148	1.900	2.006	3.906	382
	Pingtung County	1.346	1.668	-0.322	3.015	2.539	2.861	5.400	162
East Region	Rilan County	1.520	1.767	-0.247	3.287	2.404	2.648	5.052	140
	Hualien County	1.197	1.138	0.060	2.335	1.963	1.902	3.865	131
	Taitung County	0.978	1.096	-0.118	2.074	1.416	1.533	2.950	62

Note: [a] Job and worker flow rate averages over 204 months from 1987 to 2003.

In order to investigate the dynamic behaviour in more detail at the regional level, data from the same dataset is reported for seven cities and fifteen counties.[25] Table 5.11 reports the average monthly rates for job creation, job destruction, job reallocation, net job change, hiring, separation and worker turnover, and the average sample size from 1987 to 2003. Several results are worth noting. First, urban areas have relatively low job reallocation rates compared to rural areas. In the North Region, for example, the monthly average job reallocation rate varies from 1.4 per cent in Taipei City[26] to 2.7 per cent in Hsinchu City. In contrast, the monthly average job reallocation rate varies from 2.4 per cent in Hsinchu County to 2.9 per cent in Taipei County.

Second, the labour market in urban areas is more ‘dynamic’ than in rural areas, which signifies more efficient information networks. In the North Region, for example, Taipei City has the lowest share (45 per cent) of worker turnover due to job reallocation. Likewise Taichung City in the Central Region and Kaohsiung City in the South Region are more dynamic in their respective regions.

Third, it is important to notice that the source of employment growth for the period 1987-2003 come from Taipei City, Hsinchu City, and Hualien County. In contrast, there is a net decrease in employment in the other areas, includes Taichung City in the Central Region and Kaoshiung City in the South Region, over the sample period. This evidence corresponds to the finding in Chapter 2 that labour-intensive services such as Finance and Tourism, which grew rapidly in the last decade, are located in Taipei City and Hualien County. The Hsinchu Science-Based Industrial Park (HSIP) in which most high-technology industries are clustered is located in Hsinchu City. Furthermore, significant falls in employment have occurred in Pingtung County, Rilan County and Milaoli County which is unsurprising because the declining agriculture sector is located mainly in these Counties.

As we discussed in Chapter 2, a wide range of factors, including government policy and the dynamics of industry specialisation have contributed to the divergent patterns of development in the seven cities and fifteen counties. In particular, competitive advantage arising from an integrated transportation network and external scale economies[27], in the Taipei metropolitan area has stimulated a rapid growth in services, including Wholesale, Industrial Service and Finance. Government regional policy has contributed to the promotion of the Tourism industry in Hualien County and the locatation of the Hsinchu Science-Based Industrial Park (HSIP) in Hsinchu City (Tsai, 2005).

5.9 Conclusion

In this Chapter, we have reviewed the basic features of job creation and job destruction. Job creation and job destruction rates are remarkably high in both advanced and developing economies. In addition, the job destruction rate fluctuates more than the job creation rate in US manufacturing, signifying countercyclical job reallocation. However, the evidence on the hypothesis of countercyclical job reallocation is mixed for Denmark, France, Germany, Italy and Sweden (Wager, 1995; Contini *et al.*, 1995; Albak and Sorensen, 1998; Gourinchas, 1999; Persson, 1999).

We discussed five theories that attempt to explain the simultaneous job creation and destruction. Passive learning theory emphasises the negative relationship between the enterprise's age and the magnitude of its gross job flows. According to creative destruction theory innovative entrepreneurs create jobs and force other establishments to destroy jobs, reduce output and lose market share. Several factors, such as search cost, hiring cost and firing cost, are alleged to slow down the job reallocation process. Mitchell and Muysken (2003) emphasise that full-time jobs are destroyed and simultaneously part-time jobs are created in downturns. The final theory emphasises that allocative disturbances dominate fluctuations in the job reallocation process. Although differing in emphasis, these theories may all contribute to an explanation of the large fluctuations of job flows.[28]

In this Chapter, we have also examined the basic features of job creation and job destruction based on a unique monthly dataset. There is simultaneous job creation and destruction, as well as simultaneous hiring and separation across the three sectors. Job creation is more volatile than job destruction in the manufacturing and service sectors, but reveals the opposite pattern in the construction sector; so that countercyclical job reallocation only occurs in the construction sector. The average share of worker turnover caused by job reallocation is 52 per cent in the manufacturing sector, while it is around 44 per cent and 80 per cent in the service and construction sectors, respectively. These results indicate that worker turnover in the service sector is more dynamic than in the manufacturing and construction sectors, which implies more efficient job matching in the former.

This Chapter has also analysed the dynamics of worker turnover in Taiwan. We found that worker entry is dominated by new hires whereas worker exit is dominated by quits, and that this is consistent by sector and net employment change. Moreover, based on the Manpower Utilisation Survey, we found that the main reasons for job changers leaving their last jobs are low pay and the expectation of workplace closure or business downsizing. Unfortunately, given the data limitations we were unable to investigate the voluntary and involuntary components of quits in more detail.

Finally, we found that the North Region is more dynamic than the other three regions, as revealed by job reallocation representing a lower share of worker turnover. In this context greater dynamism means that vacancies are filled relatively quickly, since job destruction and job creation which have occurred in the same survey month are not recorded as part of the figure for job reallocation, as illustrated in Table 5.3.

Finally, the main sources of aggregate employment growth for the period 1987-2003 are Taipei City, Hsinchu City, and Hualien County. This evidence corresponds to the finding in Chapter 2 that labour-intensive services such as Finance and Tourism, which grew rapidly in the last decade, are located in Taipei City and Hualien County. The Hsinchu Science-Based Industrial Park (HSIP) in which most high-technology industries are clustered is located in Hsinchu City.

Appendix: Regional areas of Taiwan

North Region:	Taipei City, Keelung City, Hsinchu City, Taipei County, Taoyuan County, Hsinchu County.
Central Region:	Taichung City, Taichung County, Miaoli County, Changhua County, Nantou County, Yunlin County.
South Region:	Kaohsiung City, Tainan City, Chiayi City, Kaohsiung County, Tainan County, Chiayi County, Pingtung County.
East Region:	Rilan County, Hualien County, Taitung County.

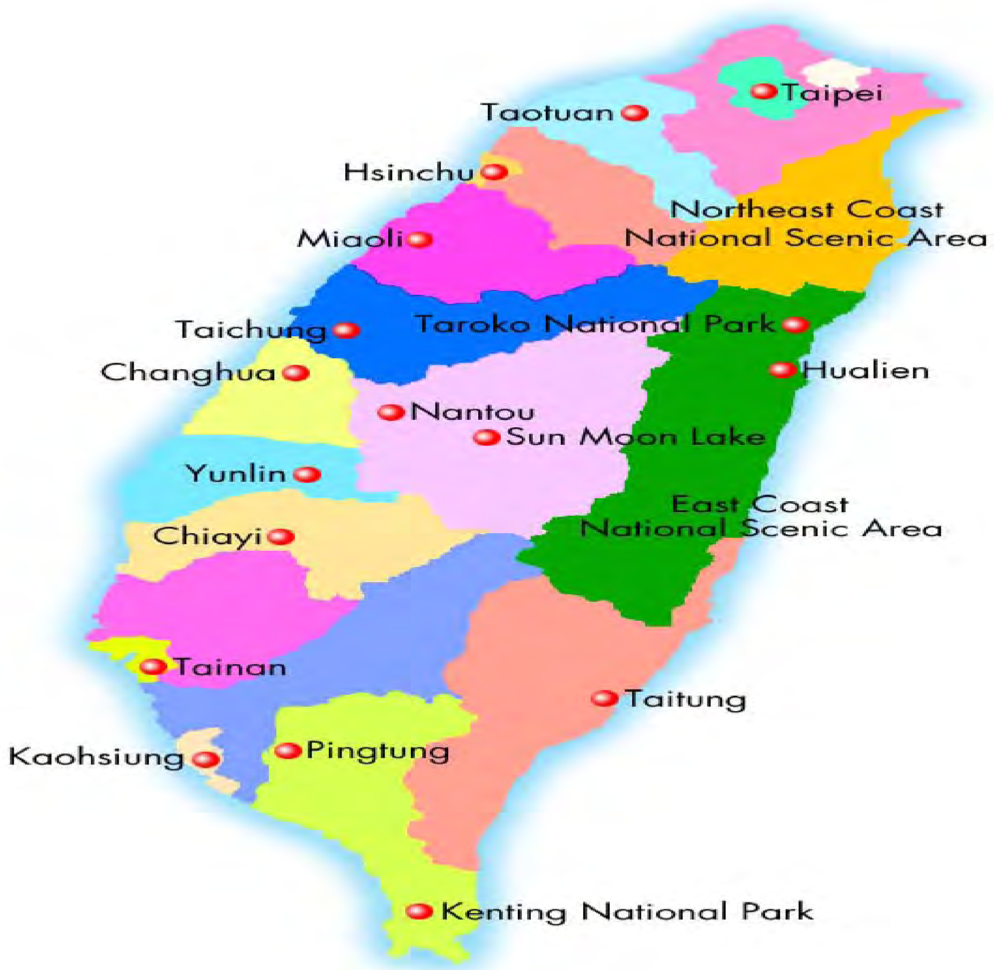


Figure A1 The main cities and counties in Taiwan
Source: http://www.map.com.tw/

Notes:

---

[1] Meanwhile, Haltiwanger *et al.* (2004) find that around 15 per cent of jobs are created and 16 per cent of jobs are destroyed each year between 1992 and 2000 in the Brazil.

[2] Measurement problems were discussed in more detail in Chapter 3.

[3] Turnover is defined as an employee voluntarily or involuntarily leaving her/his organisation (Price, 1977; Bluedorn, 1978). Dalton *et al.* (1981) further classify turnover into dysfunctional turnover and functional turnover. Dysfunctional turnover is defined as the individual wants to leave the organisation but the organisation prefers to retain the individual. In contrast, functional turnover is defined as an individual wanting to leave the organisation, but the organisation is unconcerned because the organisation has a negative evaluation of the individual. In the present chapter, we follow Davis and Haltiwanger (1992) who consider job turnover as increases and decreases in plant-level employment, which can be defined in terms of job creation (JC), job destruction (JD), net employment change (NET) and job reallocation (JR). Please see Chapter 3 for more illustrations of these measures.

[4] Gross job reallocation cannot capture the feature of job creation and destruction that occur in the same month. Furthermore, unlike excess job reallocation, gross job reallocation also rises with the absolute value of net employment change. As a consequence, excess job reallocation is a more appropriate index of simultaneous job creation and destruction than is gross job reallocation (Davis and Haltiwanger, 1996b).

[5] The figure for excess job reallocation (EX) is either double job creation (JC) or job destruction (JD). If *JC* is larger than *JD*, *EX* is twice *JD*. Otherwise it is twice *JC*.

[6] The authors find that 75 per cent (95 per cent) of the four-digit manufacturing industries exhibit average excess job reallocation rates greater than 10 per cent (6 per cent) of employment per year.

[7] The excess job reallocation rate averages 34.6 per cent of employment per year for

establishments with fewer than 20 employees, 10.7 per cent for establishments with 500-999 employees, and 7.7 per cent for establishments with 50,000 or more employees.

[8] In Chapter 2, we show that Taiwan's economy has been dominated by the service sector in terms of shares of GDP and employment since the late 1980s.

[9] For example, using annual data, if a plant lays off some workers in March 2005 and recalls an equal number in August 2005, then no contribution to job creation and destruction would be recorded for these events in 2005, but these events would be recorded separately if quarterly data were used.

[10] The cyclical behaviour of the reallocation rate depends on the changing absolute magnitudes of each and not their relative magnitudes, as such. In other words, the job creation rate could collapse in downturns, and the job destruction rate would have to be higher, but the sum of the two rates could be less than the sum in the upturn. As a result, the variance condition is sufficient to identify the countercyclical behaviour of reallocation.

[11] The newly industrialising economies (NIEs) are defined as those economies that have not yet reached advanced economy status but have been undergoing rapid economic growth and have been growing faster their developing counterparts (Ministry of Economic Affairs, Taiwan; 2007).

[12] The Other Services sector includes Transport, Electricity, Gas and Water, Communication, Finance and Insurance, Property and Business Services, Accommodation, Café and Restaurants, Education; Cultural and Recreational Services; and Personal and Other Services.

[13] Mitchell and Muysken (2003) consider that full-time employment, such as white collar administration and supervisory positions, is typically associated with features of 'primary' jobs (on-going training commitments, better wages, higher productivity, and stable work patterns). In contrast, workers in part-time employment are typically less well-paid, generate lower productivity, have less secure tenure. These features are

representative of 'secondary' jobs. However, Mitchell and Muysken (2003) are silent with regard to the part-time jobs in the primary and secondary sectors

[14] Several research studies have found that innovation is the basis for the changes in firms' shares of employment (for example, Tether and Massini, 1998; Gentry and Hubbard, 2004; Yang and Lin, 2008).

[15] Other research that explores job reallocation and worker turnover based on a common data source includes: Anderson and Meyer (1994) in US; Boeri (1994) in Germany; Hamermesh *et al.* (1996) in Netherlands; Serrano (1998) and Abowd *et al.* (1999) in France.

[16] For example, the job creation rate in 1987 is measured as the sum of monthly rates and then divided by 12.

[17] On the other hand, 'simultaneous' job creation and job destruction in the same survey month does not have any impact on aggregated monthly job flows over the year but would affect the calculation of worker turnover. The reason is that job flows count jobs (net employment change) each month, while worker turnover counts individuals.

[18] The netting out problem would be reduced but not eliminated if vacancies were filled instantaneously whether vacancies arose from workers truly voluntary turnover or employer initiated turnover or from a desired expansion of employment.

[19] Moreno (2007) emphasise that job instability, which result from organisational changes, has a positive effect on aggregate job turnover. In contrast, Matouschek *et al.* (2008) propose a model in which the job instability caused by policy reform, such as a reduction in firing taxes. A positive relationship between job instability and worker turnover has been found in the empirical analysis of Cappelli and Neumark (2001) in US, Erlinghagen and Knuth in West Germany and Askenazy and Moreno (2007) in France.

[20] Constant employment plants are defined as these establishments whose net

employment change is zero between years t and $t + 1$.

[21] If we could observe the employer employee interaction behind the large component of quits, we could make a judgment whether a separation is initiated by employees or employers.

[22] Research has been undertaken to analyse workers' reasons for quitting. For example, Sicherman (1996) explores the quit behaviour of men and women with a unique dataset of a large insurance company in US during the period 1971-80. Based on 23299 observations, Sicherman (1996) finds that a higher proportion of women than men quit their jobs for reasons such as household duties and illness in the family. Recently, Delfgaauw (2007) finds that workers in the Dutch public sector in 2002 quit their jobs because of low pay, work pressure, working conditions and job duties.

[23] On the other hand, netting out with respect to annual data arises because of job creation and job destruction occurring in separate months of the same year.

[24] It is important to emphasise that more worker turnover (denominator) in response to fast employment growth does not mean a higher level of dynamism if the job reallocation (numerator) is similarly affected leaving the share unchanged.

[25] The seven cities are located in urban areas. In rural areas (for example, the East Region) county data are employed because the towns are small.

[26] Taipei City is the capital city of Taiwan.

[27] External scale economies refer to agglomerative externalities between firms and market linkages. For example, a firm could be located in close proximity to its market in order to reduce transport costs (Anas *et al.*, 1998).

[28] These five theories explain the heterogeneous behaviour of gross job flows from different perspectives. It would be difficult to empirically differentiate between these hypotheses.

Chapter 6 Methodology

6.1 Introduction

This Chapter outlines the econometric and statistical methods that are employed in the next two chapters of this thesis. These methodologies include the estimation of univariate and multivariate Markov-switching autoregressive (MS-AR) models; analysis using Pearson's contingency coefficient, Fisher's exact test and nonlinear impulse response analysis. These methodologies are suitable for the task at hand and provide different insights into the time series dynamics that are present in the data. The leading choices in the class of linear time series models include autoregressive (AR) models, moving average (MA) models, and vector ARIMA models. These linear models have been popularised by their inclusion in several leading econometric modelling software packages which have promoted their ease of use. Despite these attractive advantages, linear time series models are unable to represent many non-linear dynamic patterns such as regime switching and asymmetry which plausibly arise in real world data. For example, real GDP growth usually exhibits high volatility, is more persistent during expansion, and is prone to behave asymmetrically in response to an exogenous shock (Hamilton, 1994). A single linear model is unable to adequately characterise these distinctive features.

Over the last two decades, the literature on non-linear time series models has grown rapidly (see Greene, 2003). However, non-linear models also possess known limitations. First, making non-linear models operational in a modelling context is particularly complicated and time-consuming. For example, in order to avoid getting a local optimum in the parameter space, Juan *et al.* (2005) take 20 hours using a Pentium 4 processor to find global convergence after trying several different vectors of starting values in the estimation process. Second, most non-linear time series models are designed for specific applications and do not generalise easily, which suggests they may not be as flexible as one would like.

In the context of the benefits and costs of non-linear models, the main methodology employed in this thesis is the Markov switching model. Since the pioneering studies by Hamilton (1989, 1990), the Markov-switching autoregressive (MS-AR) model has been employed widely in the empirical macroeconomics. The MS-AR model involves multiple structures that capture different regimes of the time series variables. A special feature of the MS-AR model is that the switching mechanism is controlled by an unobservable state variable that follows a first-order Markov chain. The Markovian property requires that the current value of the state variable depends on its immediate past value. This innovation is in sharp contrast to the switching model of Quandt (1972) in which the switching mechanism is not time or path dependent. Importantly, the Markov switching model is able to describe various stylised facts about the behaviour of time series, including persistence, asymmetry, the timing of switches and cyclical sensitivity. In the US, for example, Davis and Haltiwanger (1996b) find that job creation is more persistent during expansion than that during recession. Moreover, job creation and job destruction have an asymmetric response to the change in the federal funds rate in the US (Garibaldi, 1997; Davis and Haltiwanger, 2001). Thus, the Markov switching model is suitable to explore the dynamics of job creation and destruction processes over time.

This chapter will introduce the theoretical underpinnings of the MS-AR model and its variations, as well as their empirical applications. The chapter is organised as follows. In Section two, we introduce the Markov-switching vector autoregressive process. This Section also includes the Maximum Likelihood (ML) estimation, the MS-AR model selection process and multivariate MS-AR models. The Markov switching model with exogenous variables will be discussed in Section three. Section four introduces Pearson's contingency coefficient and Fisher's exact test. Section five discusses the application of multivariate MS-AR models while nonlinear impulse response analysis is presented in Section six. Section seven concludes this Chapter.

6.2 Markov Switching Models

6.2.1 Markov-switching vector autoregressive processes

The theoretical and empirical literature examining business cycle dynamics has grown rapidly since Hamilton (1989) introduced a new approach, the so-called Markov-switching (MS) model. The MS model has two main advantages. First, it is able to describe how macroeconomic activity switches between different regimes. For example, the growth period of an economy may be characterised by sequences of fast and slow growth phases. The switching process used in the MS-AR model is described by a Markov chain. Compared with arbitrary dating methods that have been used to identify turning points in the business cycle, such as those developed by the National Bureau of Economic Research (NBER), the MS model offers a statistical basis for determining cyclical phases. Second, the MS model is able to estimate the persistence of each regime. Thus, Quandt's (1972) assumption that switching events are not time or path dependent is relaxed.

In deploying the MS-AR model as the major modelling methodology of this thesis, we assume that a parameter (the rate of job creation or job destruction) depends on a stochastic, unobservable regime variable (s_t). The regimes are based on the different conditional distributions of the job creation or job destruction rates. The innovation in the MS model is assumed to be homoskedastic although this can be relaxed if heteroskedasticity is detected. The standard MSM(M)-AR(p) model is written as:

(6.1) $$x_t - \mu(s_t) = \sum_{k=1}^{p} \alpha_k (x_{t-k} - \mu(s_{t-k})) + u_t, \qquad u_t | s_t \sim NID(0, \sigma^2).$$

$s_t \in \{1, ..., M\}$ is generated by a Markov chain. The transition probabilities between regimes are time-invariant, so that the probability of a switch between regimes i and j is the same over time.

(6.2) $$p_{ij} = prob(s_{t+1} = j | s_t = i), \qquad \sum_{j=1}^{M} p_{ij} = 1, \qquad \forall i, j \in \{1, ..., M\}.$$

The MSM(M)-AR(p) indicates an immediate one-time-jump in the mean process after a change in the regime. However, it is more plausible that the job creation or job destruction rates approach a new level smoothly after the transition from one regime to another. To represent these cases, the MSI(M)-AR(p) model is used, rather than the MSM(M)-AR(p). Accordingly,

$$(6.3) \qquad x_t = \mu(s_t) + \sum_{j=1}^{p} \alpha_j x_{t-j} + u_{t,} \qquad\qquad u_t | s_t \sim NID(o, \sigma^2)$$

In empirical studies, only some parameters will be conditional on the state of the Markov chain, while other parameters will be regime invariant. In order to design a unique notation for each model, Krolzig (1997) specifies the general MS model with the regime-dependent parameters:[1]

M Markov-switching *mean,*

I Markov-switching *intercept* term,

A Markov-switching *autoregressive parameters,*

H Markov-switching *heteroskedasticity.*

Table 6.1 introduces the variety of specifications for the MS-AR model that arise from this categorisation scheme. The MS-AR model thus provides a very flexible framework which allows the non-linear time series to display heteroskedasticity, and occasional mean shifts, in addition to reversing trends.

Table 6.1 Special Markov Switching Autoregressive Models

		MSM	MSI Specification		
		μ varying	μ invariant	ν varying	ν invariant
Ai invariant	Σ invariant	MSM-VAR	linear MVAR	MSI-VAR	linear VAR
	Σ varying	MSMH-VAR	MSH-MVAR	MSIH-VAR	MSH-VAR
Aj varying	Σ invariant	MSMA-VAR	MSA-MVAR	MSIA-VAR	MSA-VAR
	Σ varying	MSMAH-VAR	MSAH-MVAR	MSIAH-VAR	MSAH-VAR

Note: Ai and Aj indicate autoregressive parameters are invariant and varying, respectively.

For example, in both the MSM(M)-AR(p) and MSI(M)-AR(p) models, one can relax the assumption that the white noise process u_t is homoskedastic and instead employ regime-dependent heteroskedasticity of u_t.

(6.4) $$u_t | s_t \sim NID(0, \sigma^2 | s_t)$$

6.2.2 Estimation

There are various ways to estimate the Markov switching model (see Hamilton, 1989, 1990, 1994). The two main approaches are Maximum likelihood (ML) estimation and Gibbs sampling. Gibbs sampling is a Markov Chain Monte Carlo simulation method (also known as MCMC method) introduced by Geman and Geman (1984) for image processing analysis. The main advantage of Gibbs sampling is that the simulation method enables researchers to obtain new insights into unknown parameters. However, without prior information, Gibbs sampling produces the posterior parameter distribution in the same way as Maximum Likelihood estimation. In this section, we focus on the Maximum Likelihood estimation proposed by Hamilton (1990). The process of maximising the likelihood function of an MS-AR model iteratively estimates the parameters of the autoregression and the transition probabilities governing the Markov chain of the unobserved states. The parameter vector $\lambda = (\theta, \rho)$ is chosen such that the likelihood is maximised for given observations.

The Expectation Maximisation (EM) algorithm, introduced by Dempster *et al.* (1977), generates maximum likelihood estimates for parameters in MS-AR models. There are two steps in the Expectation Maximisation (EM) algorithm. First, the expectation involves a pass through a filtering and smoothing algorithm, using the parameter vector $\lambda^{(j-1)}$ of the last maximisation step, in place of the unknown true parameter vector. This step produces an estimation of the smoothed probabilities $P(\xi | Y, \lambda^{(j-1)})$ of the unobserved states ξ_t (where ξ denotes the history of the Markov chain). Second, in the maximisation step, the estimation of the parameter vector λ is produced as a solution $\tilde{\lambda}$ of the first-order conditions with the likelihood function, while the conditional regime probabilities $P(\xi | Y, \lambda)$ are changed with the smoothed probabilities $P(\xi | Y, \lambda^{(j-1)})$ produced in the last expectation step. As a result, for the new parameter vector λ, the filtered and smoothed probabilities are changed in the next expectation step so that the value of likelihood function will increase at each step. These statistical techniques provide inference for ξ_t given a specified observation set $Y_\tau, \tau \le T$ which reconstructs the time path of the regime $\{\xi_t\}_{t=1}^{T}$ under and alternative information set:

$\hat{\xi}_{t|\tau}, \quad \tau < t$ predicted regime probabilities

$\hat{\xi}_{t|\tau}, \quad \tau = t$ filtered regime probabilities

$\hat{\xi}_{t|\tau}, \quad t < \tau \le T$ smoothed regime probabilities

In empirical studies, all of the filtered regime probabilities ($\hat{\xi}_{t|t}$), the one-step predicted regime probabilities ($\hat{\xi}_{t|t-1}$) and the full-sample smoothed regime probabilities ($\hat{\xi}_{t|T}$), are considered.

6.2.3 MS-AR Model Selection

In this section, we discuss the steps necessary to select an appropriate MS-AR model from the array of contending models available. Choosing the number of regimes is a crucial step in the specification of the MS-AR model. Due to the existence of a nuisance parameter under the null hypothesis, the likelihood ratio test statistic for testing the number of regimes does not possess an asymptotic χ^2 distribution. One choice is to employ the procedures designed by Hansen (1992, 1996) and Garcia (1998). However, their process is complicated and time-consuming (Krolzig, 2001).

Another choice, proposed by Krolzig (1997), is based on the Auto-Regressive Moving Average (ARMA) - representation of the MSM(M)-AR(q) or MSI(M)-AR(q). Poskitt and Chung (1996) initially consider the ARMA representation of a hidden Markov chain model. Krolzig (1997) then enriches the hidden Markov chain model with autoregressive dynamics which leads to MSI(M)-AR(p) and MSM(M)-AR(P) processes. Krolzig (1997) describes the correspondence between ARMA models and the MS-VAR process by deriving the autocovariance function (ACF), which provides a way to determine the parameters in the ARMA(p, q) model as well as in MSM-AR and MSI-AR models. This procedure is designed as follows: First, the choice of univariate ARMA model is decided on the basis of the likelihood criterion (for example, Akaike

Information Criterion – AIC and Schwarz criterion - SC). Second, the MS(M)-AR(*p*) can be carried out from the ARMA model (see Table 6.2 and 6.3). Third, MS(M)-AR(*p*) models can been seen as a point of departure in a general-to-specific modelling strategy. The final stage of our selection procedure is to compare the different types of selected models. The comparison is based on the following criteria. First, the log-likelihood function is considered. Second, the relationship between regime switching behaviour and the macroeconomic fundamentals is considered. The latter criterion is particularly crucial. The best model is arrived by confronting the regime switching behaviour for each variable with the business cycle dates provided by the official agency - the Taiwanese Council for Economic Planning and Development (CEPD).[2]

Table 6.2 ARMA representations of MS-AR models

MSI(M)-AR(p),p>0	>	ARMA(M+p-1, M-1)
MSM(M)-AR(p),p>0	>	ARMA(M+p-1, M+p-2)

Source: Krolzig (1997: p. 133)

Table 6.3 Selection of MS-AR model

ARMA(p,q)	MSI(M)-AR(p) Model	MSM(M)-AR(p) Model
p<q		
$p = q \geq 1$	MSI(q+1)-AR(0)	MSM(q+1)-AR(0)
$p = q + 1 \geq 2$	MSI(q+1)-AR(1)	MSI(M)-AR(p-M+1), $M \in \{2,..., p\}$
$p > q + 1 \geq 2$	MSI(q+1)-AR(p-q)	

Source: Krolzig (1997: p. 134)

6.2.4 The Multivariate MS-AR Model

A number of studies (for example, Phillips, 1991; Filardo, 1994; Artis *et al.*, 2004) have examined the global or international business cycle based on the multivariate Markov switching model. One distinctive advantage of the Markov Switching vector autoregression, or simply, MS-VAR, is that this model is able to extract the common cyclical behaviour among multi-time series. Krolzig (1997) proposes a specification strategy for Markov-switching models of multiple time series. The pre-selection of the number of regimes M* can be obtained from the univariate MS-AR model analyses of each component of the time series vector. The autoregressive order *p** is then based on the log-likelihood function and the macroeconomic fundamentals.

For example, in the case of the international business cycle, the system of annual real GDP would be

$$(6.5) \qquad x_t = [x_t^{US}, \quad x_t^{JAP}, \quad x_t^{FRG}, \quad x_t^{UK}, \quad x_t^{CAN}, \quad x_t^{AUS}]$$

where the superscripts US, JAP, FRG, UK, CAN, AUS denote the different countries under consideration (this example is from Krolzig, 1997). Similar to the univariate MS-AR model, the regime-generating process is also assumed to follow a Markov chain with a constant transition probability p_{ij}, so that in the *k* regime case:

$$(6.6) \qquad p_{ij} = prob(s_{t+1} = j \mid s_t = i). \qquad \sum_{j=1}^{k} p_{ij} = 1 \qquad \forall i, j \in \{1,...,k\}$$

It is also assumed that some parameters are regime-invariant so that only some of the parameters are conditional on the variant regime of the Markov chain (Krolzig, 1997). A three-regime Markov-switching vector autoregression with only shifts in the intercepts (v) and regime-dependent covariances can be considered as shown below:

(6.7) $$x_t = v(s_t) + A_1 x_{t-1} + u_t, \qquad u_t | s_t \sim NID(0, \Sigma(s_t))$$

6.3 Extension of the MS-AR Models

Equations 6.1 and 6.3 make two necessary assumptions in the specification of MS-AR models. First, the model is autonomous. In other words, the system excludes the influence of exogenous variables. Second, the hidden Markov chain is homogenous because the transition probabilities are time-invariant. In the next section, the Markov Switching model with exogenous variables (ARX) is introduced. We then discuss the applications of MS-AR models in empirical studies.

6.3.1 Markov Switching Model with Exogenous Variables

In the basic MS-AR model, we have assumed that all variables and regime generation processes are decided (endogenously) within the model. However, in practice, the regime generation process may be influenced by omitted or unobserved variables (for example, monetary policy or oil price, etc.) outside the system under consideration.

The Markov Switching model with exogenous variables can be represented as:

(6.8) $$y_t = \mu(s_t) + \sum_{j=1}^{p} \alpha_j (s_t) y_{t-j} + \sum_{i=1}^{r} \beta_i (s_t) X_{t-r} + u_{t,}$$

where $u_t \sim NID(0, \Sigma(s_t))$, and α_i and β_j are coefficient matrixes. The vector X_{t-r} represents exogenous variables. Equation (6.8) denotes the general form of MS(M)-ARX(*q*), where all parameters are regime dependent. In practice, the coefficient matrices α_i and β_j may not be regime dependent. In this case, Equation (6.8) can then be represented as the MSI(M)-ARX(q) model:

(6.9) $$y_t = \mu(s_t) + \sum_{j=1}^{p} \alpha_j y_{t-j} + \sum_{i=1}^{r} \beta_i X_{t-r} + u_{t,}$$

The statistical analysis of the MSI(M)-ARX(*q*) model can be performed as a straightforward extension with the conditional densities $p(y_t | \xi_t, y_{t-1}, X_t)$. The likelihood function can be presented as

(6.10) $$L(\lambda) = \int p(y, \xi | Z, \lambda) d\xi = \sum_{t=1}^{T} \eta_t' \hat{\xi}_{t|t-1}$$

where

$$\eta_t = \begin{bmatrix} p(y_t | Y_{t-1}, \xi_t = 1, X_t \\ \vdots \\ p(y_t | Y_{t-1}, \xi_t = M, X_t) \end{bmatrix}, \quad \hat{\xi}_{t|t-1} = \begin{bmatrix} p(\xi_t = 1 | Y_{t-1}, X_{t-1}) \\ \vdots \\ p(\xi_t = M | Y_{t-1}, X_{t-1}) \end{bmatrix}$$

and $Z = X_T$. The estimation of the parameter vectors is presented as

$b = vec(\beta_0, \beta_1, \cdots, \beta_q)$. The ML estimator of the equation is

$$\frac{\partial \ln L}{\partial b'} = \int \frac{\partial \ln p(Y|\xi_t, Z, \lambda)}{\partial b'} p(\xi|Y, Z, \lambda) d\xi = \sum_{t=1}^{T} \sum_{m=1}^{M} \frac{\partial \ln p(y_y|Y_{t-1}, \xi_t, X_t)}{\partial b'} p(\xi_t = m|T_{t-1}, X_{t-1}) = 0$$

6.3.2 The Applications of MS-AR Models

Since Hamilton (1989) introduced the Markov switching model, this model and its variants have been widely used to analyse the economic and financial time series (for example, Engel and Hamilton, 1990; Goodwin and Sweeney, 1993; Filardo, 1994; Kim and Yoo, 1995; Garcia and Perron, 1996; Schaller and van Norden, 1997; Kim and Nelson, 1998; Huang, 1999; Kirikos, 2000; Chen, 2001). Hamilton and Raj (2002) provide a state-of-the-art overview of new directions in methods and results for estimation and inference based on the application of Markov-switching models. In the present section, we review several interesting applications of Markov switching models in business cycles.

Kim and Murray (2002) propose a generalisation of the Markov switching model that allows researchers to decompose recessions into permanent and transitory components. They explore the regime switching behaviour of permanent and transitory components in a monthly vector system including industrial production, personal income, sales and employment. Kim and Murray (2002) find that the transitory component of recessions accounts for between 77 per cent and 96 per cent of the observed variance of monthly indicator series, and suggest the US business cycle exhibits three-phase characterisations: recession, high-growth recovery as the output reverts to its previous peak, followed by a normal growth phase.

Chauvet *et al.* (2002) develop a dynamic Markov switching factor model to examine business cycle fluctuations in US unemployment rates. This model is able to extract the common dynamics among unemployment rates disaggregated across seven age groups. The framework allows analysis of the separate contribution of changes due to asymmetric business cycle fluctuations. Chauvet *et al.* (2002) find strong evidence in favour of the common factor between high and low unemployment rate regimes. Chauvet *et al.* (2002) also find that demographic adjustments can account for a great deal of the secular changes in the unemployment rates, especially the sudden increase in the 1970s and 1980s and the subsequent decrease in the last 18 years.

Kaufmann (2002) applies a univariate Markov switching model to assess whether monetary policy effects are asymmetric over the business cycle. Kaufmann (2002) uses the first difference of the 3-month Austrian interest rate as a measure for monetary policy. The asymmetry of the influences was specified by allowing for state-dependent parameters where the latent state variable follows a Markov switching process. The model is estimated within a Bayesian framework using Markov Chain Monte Carlo simulation methods (Gibbs sampling). The results reveal significant negative effects of monetary policy during periods of contraction, while there is a weaker influence during periods of expansion.

The Markov Switching model with exogenous variables first appeared in business cycle studies in Clements and Krolzig (2002). The authors consider whether oil prices can account for business cycle asymmetries.[3] Their initial test for asymmetries was based on the Markov switching autoregressive model popularised by Hamilton (1989), using tests that the authors developed previously (Clements and Krolzig 2000). They find evidence of steepness (that is, contractions are steeper than expansions; see Sichel, 1993) in both output and employment growth. Clements and Krolzig (2002) also find evidence of sharpness (that is, troughs are 'sharp' and peaks are more rounded; see McQueen and Thorley, 1993), which suggests the economy is more likely to move from recession to a high growth recovery than to move in the reverse direction. Finally, based on the MS-ARX model, Clements and Krolzig (2002) find that oil price shocks cannot explain the asymmetries detected in the business cycle.

Recently, Cologni and Manera (2006) also apply the MS-ARX model to explore the asymmetric effects of oil shocks on output growth in the G-7 countries.[4] They initially employ the univariate MS-AR models to describe the different regime switches for the G-7 countries. They find that the null hypothesis of linearity against the alternative of an MS specification is rejected by the data. This suggests that regime-dependent models should be used if the researcher is interested in obtaining statistically adequate representations of the output growth process. Cologni and Manera (2006) also find that three-regime MS-AR models typically outperform the corresponding two-regime specifications in describing the business cycle features for each country. Cologni and Manera (2006) then extend these models to verify if the inclusion of asymmetric oil shocks as an exogenous variable improves the ability of each specification to identify the different phases of the business cycle for each country. Based on the definitions of positive oil price changes, net oil price increases and oil price volatility, the models with exogenous oil variables generally outperform the corresponding univariate specifications which exclude oil from the analysis.

In summary, the univariate Markov switching model has successfully characterised the dynamic features of business cycles, for which the variables are represented as GDP and unemployment rate, and industrial production. Moreover, the Markov Switching model with exogenous variables (MS-ARX) model is suitable to describe the asymmetric behaviour of the business cycle and its relationship with exogenous shocks. In this thesis, we initially employ the univariate Markov switching model to explore the regime switching behaviour of job creation and destruction by industry sector and region. The MS-ARX model is then employed to examine the asymmetric behaviour of job creation and destruction. We focus on whether monetary policy can explain the asymmetric behaviour of job creation and destruction.[5]

6.4 Pearson's contingency coefficient and Fisher's exact test

In addition to the MS models, we will also employ the Pearson's contingency coefficient and the Fisher's exact test to examine whether there is correlation among regimes across variables. In the next section, the Pearson's contingency coefficient is introduced. We then discuss the formulation of Fisher's exact test.

6.4.1 Pearson's contingency coefficient

Based on the MS models, the classification of regimes is obtained from the smoothed probabilities. We denote expansion by one and denote contraction by zero. For a region pair (*i*, *j*) over the sample period, a 2×2 contingency table will be obtained for expansion and contraction frequencies.

Table 6.4 Contingency table

		Region j		
		Expansion	Recession	Subtotal
Region i	Expansion	N_{11}	N_{12}	$N_{1\cdot}$
	Recession	N_{21}	N_{22}	$N_{2\cdot}$
	Subtotal	$N_{\cdot 1}$	$N_{\cdot 2}$	N

Notes: N is defined as the number of month. For example, N_{11} is measured as the number of months which classified as expansion in both Region i and Region j.

Table 6.4 reports the contingency table for two regions (i, j). This table allows us to investigate the business cycle phases defined by the smoothed probabilities. The relationship between business cycle phases can be ascertained by employing a traditional contingency table statistic, such as the well-known Pearson's contingency coefficient, expressed as a percentage and corrected to lie in the range 0-100. The

Pearson's contingency coefficient is defined as

(6.11) $$PCC = \sqrt{\frac{\hat{X}^2}{N + \hat{X}^2}}$$

where $$\hat{X}^2 = \sum_{i=1}^{1}\sum_{j=0}^{1}\frac{(N_{ij} - (N_{i\_}N_{\_j}/N))^2}{(N_{i\_}N_{\_j}/N)}$$

The Pearson's contingency coefficient is similar to the traditional correlation coefficient for continuous data. In order to facilitate interpretation, the Pearson's contingency coefficient is converted to a statistic which lies between 1 and 100 by dividing by $\sqrt{0.5}$. As a result, PCC $_{corr}$

(6.12) $$PCC_{corr} = \frac{PCC}{\sqrt{0.5}} * 100$$

If the two binary series are independent, so that $N_{ij} = N_{i\_} * N_{j\_}$, then PCC takes the value zero. For the case of complete dependence, PCC= $\sqrt{0.5}$, and PCC_{corr}=100. In practice, a finding of independence would mean that there is no contemporaneous relationship between the business cycle regimes (expansion and contraction). In contrast, a finding of complete dependence would indicate that the two regions are processing in a similar trajectory for every time period and hence have a common regional business cycle.

Artis *et al.* (2004) apply Pearson's contingency coefficient to investigate the synchronous nature of business cycles across European countries (Germany, UK, France, Italy, Netherlands, Austria, Portugal, Spain and Belgium). They find that there is a high degree of commonality for almost all European countries with the exception of the UK. The expansions and contractions of UK do not have significant synchronous features with other European countries when using 0.5 as the threshold level.

6.4.2 Fisher's exact test

One limitation of the Pearson's contingency coefficient is that it is unreliable if the elements below five (Agresti; 1996). The alternative choice is the Fisher's exact test which was proposed by the British statistician R A. Fisher in 1934. For a 2 × 2 contingency table, under H_0: independence, conditioning on both set of marginal totals yields the hypergeometric distribution:

$$(6.13) \qquad p(t) = P(N_{11} = t) = \frac{\binom{N_{1-}}{t}\binom{N_{2-}}{N_{-1} - t}}{\binom{N}{N_{-1}}}$$

Formula 6.13 expresses the distribution of $\{n_{ij}\}$ in terms of N_{11}. To test independence, the P-value is the sum of hypergeometric probabilities for outcomes at least as favourable to the alternative hypothesis as the observed outcome. For the given marginal totals, tables having a larger N_{11} have stronger evidence in favour of H_a. Hence, the P-value is equivalent to $p(N_{11} \geq t_0)$, where t_0 denotes the observed value of N_{11}

This test for a 2 × 2 contingency table is called *Fisher's exact test* (Fisher, 1934; Mehta and Patel; 1997).

Fisher proposes the test following a comment from his colleague who claims to be able to detect whether the tea or the milk is added the cup first. Fisher designs an experiment in which four cups has milk added first and the other four has tea added first. His colleague is told there is four cups of each type and the cups are presented to his colleague in random order.

Table 6.5 Fisher's tea-tasting experiment

	Guess Poured first		
Poured first	Milk	Tea	Total
Milk	N_{11}=3	N_{21}=1	4
Tea	N_{12}=1	N_{22}=3	4
Total	4	4	

Source: Agresti (1996: p.40)

Table 6.5 shows a potential result (this example is from Agresti, 1996). The null hypothesis states that Fisher's colleague's guess is independent of the actual order of pouring; the alternative hypothesis reflects a positive association between the true order of pouring and his colleague's guess. In Table 6.5, three correct guesses of four cups have milk added first yields the null probability

$$p(3) = \frac{\binom{4}{3}\binom{4}{1}}{\binom{8}{4}} = 0.229$$

Moreover, the extreme case for four correct guesses has a probability of

$$p(4) = \frac{\binom{4}{4}\binom{4}{0}}{\binom{8}{4}} = 0.014$$

The P-vale for the one-sided alternative equals the right-tail probability that N_{11} is at least as large as observed; that is, P=P(3)+P(4)=0.243. This result does not establish an association between the actual order of pouring and the guess, which is not unexpected with such as a small sample.

In summary, Pearson's contingency coefficient and Fisher's exact test have a special advantage in exploring whether there is correlation across the variables. In the current thesis, both of these two methods will be employed to examine the relationship of job flows across regions in Taiwan. In particular, we explore if there is a co-movement activity of job flows across regions in Taiwan.

6.5 The Applications of Multivariate MS-AR Model

Burns and Mitchell (1946) define a business cycle by co-movements in several relevant economic time series. Similarly, Lucas (1977) describes a business cycle as the co-movement of important macroeconomic variables, such as production, consumption, investment and employment. More recently, Diebold and Rudebusch (1996) suggest that a model of the business cycle should consider two features: (a) the co-movement of economic variables; and (b) the persistence of economic states. A univariate Markov switching model is able to characterise the latter feature but not the former. Thus, it is necessary to move forward to consider a multivariate Markov switching model.

By comparison with the univariate Markov switching model, the application of the multivariate Markov switching model has been quite limited. Phillips (1991) is the first study to apply multivariate Markov-switching to explore the transmission of business cycles between countries. Based on seasonally adjusted industrial production for the US, Canada, Germany, and UK, Phillips (1991) shows the Markov-switching models have much better goodness of fit in a comparison with ARMA or VAR models. Phillips (1991) also finds that the recessions and booms seem to occur simultaneously across countries. However, he suggests that further research about business cycles between large industrial nations and developing countries merits consideration.

Artis *et al.* (2004) examine the existence and identification of a common European growth cycle using a multivariate Markov-switching model.[6] They initially apply a univariate Markov switching model for individual countries (Germany, UK, France, Italy, Netherlands, Austria, Portugal, Spain and Belgium) in order to detect changes in the mean growth rate of industrial production. A multivariate Markov switching vector model is then used to identify a common cycle in Europe. Artis *et al.* (2004) find two crucial results. First, a common unobserved component was governing European business cycle dynamics. This evidence suggests the existence of a common business cycle. Second, the dating of the European business cycle for an index of industrial protection and GDP is consistent.

Smith and Summers (2005) apply the multivariate Markov switching model to measure the synchronisation of business cycles across six countries (Australia, Canada, Japan, Germany, UK and US). In contrast to previous studies, Smith and Summers (2005) adopt a Bayesian method from Paap and Dijk (2003) to estimate the multivariate Markov switching model. This approach allows each variable to depend on its own Markov regime and only $2n$ transition probabilities need to be estimated. They find little evidence of a common Markov regime across the six countries. However, they find evidence of a long-run co-integrating[7] relationship between the US and Canada. Finally, Smith and Summers (2005) find that the posterior distributions of the non-parametric measures of synchronisation produced by the multivariate Markov switching autoregressive model match the data more closely than those produced by the linear VAR.

Recently, Chen and Shen (2006) apply the multivariate Markov-switching model to address the puzzle of identifying Taiwan's turning points in the 1990s.[8] Applying the univariate Markov-switching model to Taiwan's business cycle has become a focus of interest but not all attempts have been successful (see Huang, 1999; Chen and Lin, 2000; Hsu and Kuan, 2001). The univariate MS-AR model has successfully identified contraction periods before 1990 in Taiwan, but it has failed to identify the post-1990 periods as contraction. In fact, the recession period would begin in December 2000 and end in March 2002 according to the official business cycle dating provided by the Taiwanese Council for Economic Planning and Development (CEPD). Chen and Shen (2006) apply the multivariate Markov-switching factor model to solve this puzzle. They use four variables (real GDP growth, consumption expenditures, labour force and manufacturing sales) to assist in the identification of the business cycle. They find that the multivariate Markov switching model outperforms the univariate models and the MS-VAR model successfully dates Taiwan's business cycle in the post-1990 periods.

In summary, the multivariate Markov-switching model is able to characterise the co-movement behaviour among variables. In this thesis, we employ the multivariate Markov-switching model to explore the dynamic behaviour of regional business cycles. In particular, we intend to shed some light on the identification puzzle (see footnote 6) of Taiwan’s turning points in the 1990s in terms of regional business cycles.

6.6 Nonlinear impulse response analysis

Over the last decade, impulse response analysis in non-linear models has attracted considerable attention among researchers. Many previous studies use traditional impulse response analysis to analyse the response of the system with a one-step innovation (Gaussian shock). Koop *et al.* (1996) suggest the concept of general impulse response analysis in non-linear models, which differs from the traditional impulse response analysis, in terms of the invariant ordering variables in the VAR and the type of shocks. Krolzig and Toro (1998) suggest a dynamic analysis that focuses on the system subject to non-Gaussian innovation. Rewriting Equation (6.3) to denote $x_t = (x_t^{'},...,x_{t-p+1}^{'})$

(6.14) $$x_t = A(L)^{-1}v(s_t) + A(L)^{-1}\Sigma^{1/2}(s_t)u_t$$

where $A(L) = I - A_1L$ is the matrix polynomial in the lag operator L. Based on the Equation (6.14), the time series vector (x_t) of the job creation and destruction rates can be divided into a non-Gaussian component and a Gaussian component. As a result, the non-Gaussian innovations (s_t) are directly associated with the cyclical shock, the Gaussian innovations (u_t) are linked to other types of shocks which contribute to the changes in x_t.

The system to the non-cyclical shock (u_t) can be presented as

(6.15) $$\lim_{j\to\infty}\frac{\partial E_t(x_{t+j})}{\partial u_t}$$

where $E_t(x_{t+j})$ is the forecast of job creation and destruction rates at time *t+j*. In contrast, the effect on the economic system in the face of the switch from a recession ($s_t = 1$) to a moderate growth regime ($s_t = 2$) can be shown as

(6.16) $$\lim_{j\to\infty}\left\{E_t(x_{t+j}\middle|s_t = 2) - E_t(x_{t+j}\middle|s_t = 1)\right\}$$

where $E_t(x_{t+j}|s_t = i)$ is the forecast of the job creation and destruction rates of each region under regime *i*. Thus, non-linear impulse response analysis helps us to explore the influence of a recession (or an expansion) on each region.

Krolzig *et al.* (2002) apply non-linear impulse response analysis to study the dynamic adjustment of employment and its relationship with the business cycle in the UK labour market since the mid 1960s. Krolzig *et al.* (2002) find that the change from a recession to a normal growth regime leads all variables (output, employment, labour force and real earnings) to react positively and in a permanent manner to the shocks. There is also a similar picture for the transitions from a growth regime to a normal regime or a recession. However, the influence for transition from normal growth to recession is different to the switch from a normal growth to a high growth regime. As a result, the nonlinear impulse-response analysis highlights the advantages of generating regime dependent responses in a comparison with traditional VAR models.

In summary, the non-linear impulse response analysis is a superior technique when exploring variables subject to a cyclical shock, for example transition from boom to bust or vice versa. In this thesis, we employ the non-linear impulse response analysis to investigate the different influences of region subject to cyclical shocks. In particular, we are interested in which regions suffer most damage from a recession and which regions recover fastest during an expansion period.

6.7 Conclusion

In this Chapter we have introduced both univariate and multivariate Markov-switching models, as well as Pearson's contingency coefficient, Fisher's exact test and non-linear impulse response analysis. These techniques will form the bases of the applications in later chapters which aim to investigate the dynamic of job creation and job destruction in Taiwan.

Notes:

[1] Please see equations 6-1 and 6-3 for the general form of MSI-AR and MSM-AR models.

[2] The number of regimes (as well as the optimal order of autoregression) is decided by the likelihood criterion (Artis *et al.*, 2004). As was noted, the ARMA representation provide guide in selecting the number of regimes (M) and the order of the autoregression (p) in an MS-AR specification. For example, the Schwarz criterion (SC) recommend for the job creation rate in the manufacturing sector (ARMA(3,2)) corresponds to MSI(3)-AR(1), MSM(2)-AR(2) and MSM(3)-AR(1) based on the ARMA representation theorems summarised in Table 6.3. In next step, we will consider whether these three different types of selected models has superior statistical properties based on its log-likelihood function as well as its relative ability to characterise the sector’s cyclical job creation behaviour. In particular, we focus on whether these three possible candidates have fully ability to capture the recession period. As a result, the business cycle dates provided by CEPD are employed to choose the best model rather than to decide the number of regimes.

[3] Clements and Krolzig (2002) follow the definition of asymmetry (deepness, steepness, and sharpness) proposed by Sichel (1993) and McQueen and Thorley (1993).

[4] The G-7 countries are Canada, France, Germany, Italy, Japan, UK and US.

[5] During the Asian financial crisis and 2001 recession, the Central Bank of Taiwan (CBT) actively intervened in financial and labour markets. For example, the Taiwanese government reduced the discount rate 11 times over the period of the 2001 recession which was designed to stimulate investment (Yu, 2003). As a result, we explore whether the active intervention of the CBT introduced asymmetric behaviour into job creation and destruction processes in Taiwan. Please see Chapter 7 for more details.

[6] Artis *et al.* (2004) has been discussed in the section of the Pearson’s contingency coefficient.

[7] Co-integration involves testing the correlation between non-stationary time series variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be co-integrated (Greene, 2003). Engle and Granger (1987) define co-integration as follows: Components of the vector x_t are said to be co-integrated of order d, b, denote $x_t \sim CI(d,b)$, if (1) all components of x_t are I(d); (2) there exists a vector $\alpha(\neq 0)$ so that $z_t = \alpha' x_t \sim I(d-b), b > 0$. The vector α is called the co-integrating vector.

[8] The reason for this misidentification is that Taiwan experienced an average 8.5 percent GDP growth rate during expansionary periods, and 5.5 percent during contraction periods prior to 1989. After 1990, the GDP growth rate declined to 5.5 and 2.5 percent in the expansionary and contraction period, respectively. As a result, Taiwan's turning points in the post-1990 are mistakenly identified as contraction when all sample periods are analysed.

Chapter 7 Monetary policy and the asymmetric behaviour of job creation and destruction

7.1 Introduction

Between 1987 and 2003, the Taiwanese economy experienced two significant economic shocks, the first caused by the Asian financial crisis, and the second induced by the 2001 recession.[1] These events influenced the nature and intensity of the restructuring activity in the Taiwanese economy (Hwa, 2000; Yu, 2003; Ding *et al.*, 2005). In Chapter 5, we have shown that during the 2001 recession, job destruction increased sharply and this was accompanied by a moderate decline in job creation in the manufacturing and service sectors. The extent of the 2001 shock can be gauged by the fact that the unemployment rate rose from 2.69 in 1997 to the peak of 5.17 in 2002.[2] During the Asian financial crisis and 2001 recession, the Central Bank of Taiwan (CBT) actively intervened in the financial and labour markets to reduce the damage to the real economy arising from the economic turmoil and to foster full employment, steady economic growth, and stable prices.[3]

This Chapter seeks to explore whether the active intervention of the CBT during the Asian financial crisis and 2001 recession introduced asymmetric behaviour into the job creation and destruction processes in Taiwan. Sichel (1993) defines an asymmetric cycle as “one in which some phase of the cycle is different from the mirror image of the opposite phase.” One possible explanation for the asymmetric behaviour of macroeconomic aggregates is that an economy might react asymmetrically to positive shocks as opposed to negative shocks (Sichel, 1993; Baudry and Koop, 1993; Hansen and Prescott, 2002).[4] For example, Baudry and Koop (1993) find that the impact on the real economy of a negative monetary shock was more persistent than a positive monetary shock.[5] This resulted in the asymmetric behaviour in post-war US GNP. In this Chapter we are interested in whether the asymmetric behaviour of job flows is related to changes in Taiwanese monetary policy during periods of the Asian financial crisis and 2001 recession.

In the previous chapter we developed a modelling framework which allows us to investigate if there is any evidence of asymmetries in job creation and job destruction rates in Taiwan. In this Chapter, we apply formal parameter asymmetry tests (Clements and Krolzig, 2003) based on the MS-AR model and, then, to aid comparison, we employ the non-parametric test from Sichel (1993). Moreover, to link the asymmetries in job creation and job destruction to monetary policy changes, we employ the MS-ARX model.[6] Clements and Krolzig (2002) apply a MS-ARX model to examine if the oil shocks can explain the asymmetric behaviour of the US business cycle. They find that post-war economic growth is characterised by steepness (to be defined). However, Clements and Krolzig (2002) show that oil shocks cannot explain the asymmetric behaviour of the US business cycle.

Over the last fifteen years, a number of studies have explored the relationship between the cyclical behaviour of job flows and monetary shocks (for example, Garibaldi, 1997; Davis and Haltiwanger, 2001). These studies find that monetary policy has different impacts on job creation and destruction, respectively. Garibaldi (1997) applies a dynamic matching model to show how the change in the federal funds rate in the US causes different responses in job creation and job destruction. He shows that tight monetary policy increases job destruction immediately, while an easing of monetary policy causes job creation to increase, but only gradually. Davis and Haltiwanger (2001) also suggest that job destruction is more responsive to monetary policy than job creation. They explain this by arguing that the greater volatility of job destruction and its greater sensitivity to monetary shocks is a result of the rapid demise of outdated or relatively unprofitable techniques and products in a downturn. In contrast, the job creation process is less responsive to monetary shocks because of the cost of new technology.[7]

Monetary policy tools can be classified into two categories: (a) measures of the stock of money; and (b) measures of the short-term interest rate. Proponents of using the stock of money as the policy instrument argue that it determines the aggregate price level and hence inflation (McCallum, 1988, 1993). However, most central banks, including the Central Bank of Taiwan (CBT), employ the short-term interest rate as their principal monetary policy tool (Cover *et al.*, 2002; Huang and Lin, 2006). Huang and Lin (2006) assert that a reduction in interest rates makes saving less attractive and borrowing more attractive, which stimulates spending. Furthermore, changes in spending feed through into output and, in turn, into employment.

Bernanke and Blinder (1992) explore whether US monetary policy affects the real economy and how these effects work. Using Granger-causality tests, they find the interest rate on Federal funds is the best predictive indicator of future movements of real macroeconomic variables, in comparison to four other variables (M1, M2, three-month Treasury bill rate and ten-year Treasury bond rate).[8] Thus, Bernanke and Blinder (1992) suggest that interest rates be used, rather than monetary aggregates, to measure monetary policy shocks. Using changes in the funds rate to represent changes in monetary policy, they find that policy changes impact on both bank loans and bank deposits.

Several studies have analysed the impact of monetary policy in Taiwan. Emery (1987) explores the effect of Taiwan's monetary policy in dealing with the two energy crises and the impact on domestic liquidity of large trade surpluses in 1970s. He finds that tight monetary policy characterised by discount rate increases during the energy crises were not sufficient to contain inflation. Moreover, Emery (1987) finds that attempts by the CBT through open market operations to adjust domestic liquidity in response to the huge trade surpluses in the 1970s did not succeed. In contrast, Cover *et al.* (2002) explore whether the CBT would have had a more successful monetary policy during the period 1978:3 to 1999:4 if it had followed an optimal rule rather than the discretionary policies that were actually employed. Cover *et al.* (2002) employ three different instruments (discount rate, M2, and reserve money) with several different targets (the growth rate of GDP, inflation, the percentage change in the exchange rate, and the growth rate of a monetary aggregate) and find that only 4 of 64 rules[9] significantly reduced the standard deviations of both inflation and the growth rate of real GDP. Cover *et al.* (2002) conclude that the CBT in Taiwan has been very successful in using discretionary monetary policies. Based on these studies (Emery, 1987; Cover *et al.*, 2002; Huang and Lin, 2006) and the operation of the CBT in Taiwan, we thus employ the discount rate as the monetary policy instrument and explore its relationship with the cyclical behaviour of job creation and destruction.

The Chapter is organised as follows. Section 2 outlines the formal asymmetry tests based on the MS-AR model. Section 3 explores the regime switching behaviour of job creation and destruction as well as the evidences of asymmetries. Section 4 tests whether monetary policy can explain the asymmetric behaviour of job creation and destruction, which we find in section 3. Section 5 synthesises the key elements of this Chapter.

7.2 Asymmetries in MS-AR process

7.2.1 Steepness, deepness and sharpness (SDS)

Sichel (1993) defines two types of business cycle asymmetry: ‘steepness’ and ‘deepness’. Steepness occurs when contractions are steeper (or less steep) than expansions, whereas deepness occurs when troughs are deeper than peaks. Sichel (1993) devises a nonparametric test based on the coefficient of skewness measure for the detrended series to determine the presence and type of asymmetry. McQueen and Thorley (1993) outline an alternative type of asymmetry, which they term ‘sharpness or turning point asymmetry’.

Sharpness occurs when troughs are “sharp’ and peaks are more rounded. The asymmetry (deepness, steepness, and sharpness) measures used in this Chapter follow the definitions in Sichel (1993) and McQueen and Thorley (1993).

Following Sichel (1993), a process $\{x_t\}$ is defined as non-deep iff x_t is not skewed:

$$(7.1) \quad E\left[(x_t - \mu_x)^3\right] = 0$$

Similarly, Sichel (1993) defines a process $\{x_t\}$ as non-steep iff Δx_t is not skewed:

$$(7.2) \quad E\left[(\Delta x_t)^3\right] = 0$$

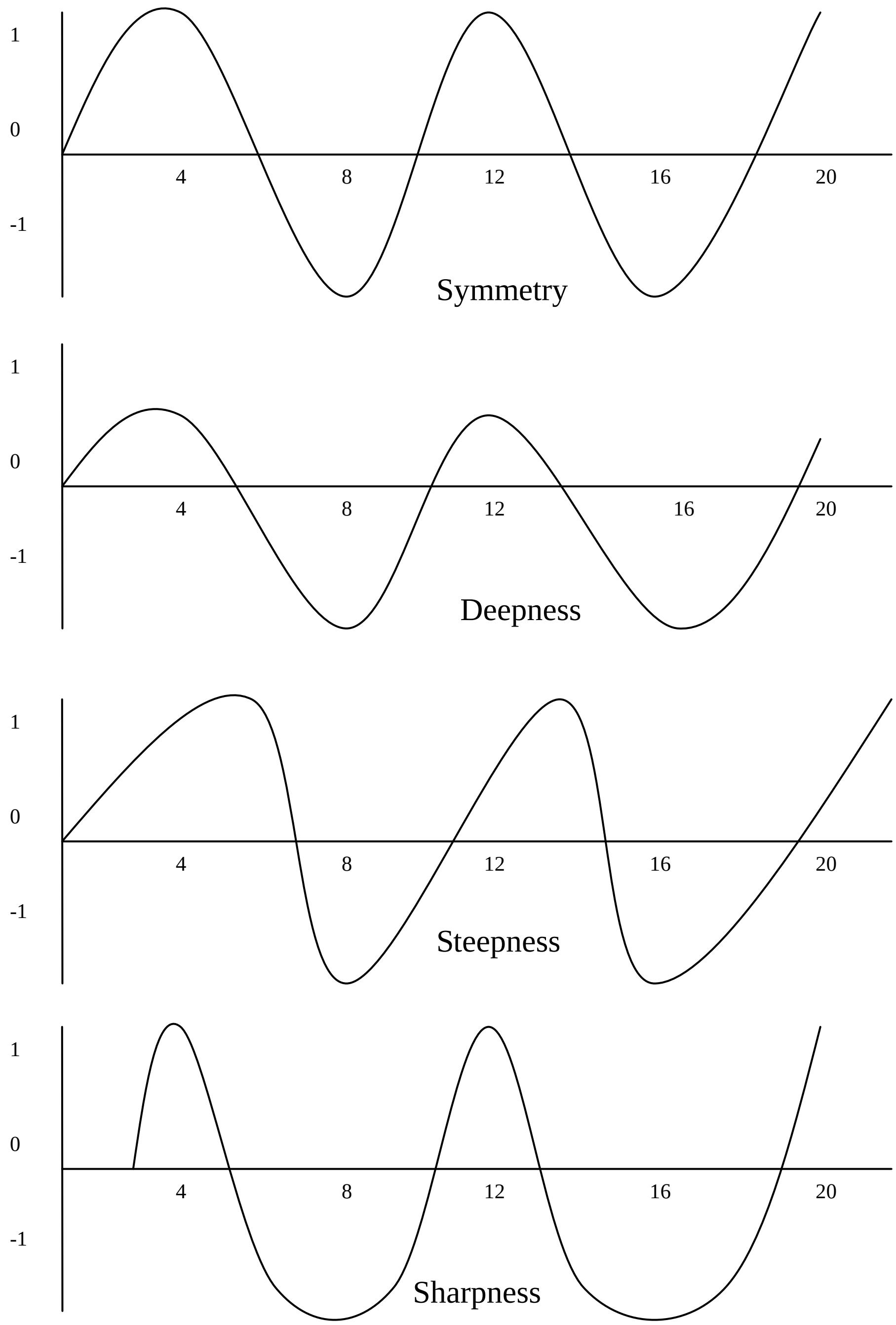
Negative skewness of x_t and Δx_t means deep and steep contractions, while positive skewness means tall and steep expansions (See Figure 7.1).

McQueen and Thorley (1993) define a process $\{x_t\}$ as non-sharp iff the transition probabilities to and from the two regimes are the same.

$$(7.3) \quad P_{m1} = P_{mM}, \; P_{1m} = P_{Mm},$$

for all $m \neq 1, M$, where M is the number of regimes, and $P_{1M} = P_{M1}$. For instance, in a two-regime model, non-sharpness means that $P_{12} = P_{21}$. However, in a three-regime model non-sharpness requires $P_{13} = P_{31}$, $P_{12} = P_{32}$ and $P_{21} = P_{23}$.

Figure 7.1 Time series plot of Symmetry, Deepness, Steepness and Sharpness



7.2.2 Asymmetries in MS-AR process

Clements and Krolzig (2003) propose formal parameter asymmetry tests based on the MS-AR model. One distinct advantage of using this test is that can detect asymmetries in the propagation mechanisms of shocks, or so-called first moment asymmetry.[10] Following Clements and Krolzig (2003), a process represented by an MSM(M)-AR(p) is non-deep iff

$$(7.4) \qquad \sum_{m=1}^{M} \overline{\xi_m}(\mu_m - \mu_x)^3 = 0$$

$\overline{\xi_m}$ is denoted as the unconditional probability of regime m, and $\mu_x = \sum_i \mu_i \overline{\xi_i}$ is denoted as the unconditional mean of x_i.

Assuming a two-regime model, the MSM(2)-AR(p) process can be written as the sum of two independent processes: $x_t - \mu_x = \mu_t + z_t$, where $E[\mu_t] = E[z_t] = 0$. Importantly, μ_t indicates the contribution of the Markov chain and z_t represents the component of shocks from the innovation. $\mu_t = (\mu_1 - \mu_2)\xi_t$, with $\xi_t = \xi_{1t} - \overline{\xi}_1$, which equal $1 - \overline{\xi}_1$ if the regime is 1 and $-\overline{\xi}_1$ otherwise. Moreover, $\mu_x = \overline{\xi}_1 \mu_1 + (1 - \overline{\xi}_1)\mu_2$ and $\overline{\xi}_1 = p_{21} / (p_{12} + p_{21})$ is the unconditional probability of regime one. Thus, the skewness of the Markov chain is obtained as:

$$E\left[(\mu_t - \mu_x)^3\right] = \overline{\xi}_1(1 - \overline{\xi}_1)\left[1 - 2\overline{\xi}_1\right](\mu_1 - \mu_2)^3.$$

Based on a prior linearity test in the Markov-switching model, this means that $\mu_1 \neq \mu_2$. The situation of non-deepness ($E\left[(\mu_t - \mu_x)^3\right] = 0$) requires $\bar{\xi}_1 = 0.5$. Therefore, non-deepness indicates that the matrix of transition probabilities must be symmetric.

Clements and Krolzig (2003) consider that a MSM(M)-AR(p) process is non-steep if the size of the jumps, $\mu_j - \mu_i$ satisfies the following criterion

$$(7.5) \quad \sum_{i=1}^{M-1} \sum_{j=i+1}^{M} (\bar{\xi}_i p_{ij} - \bar{\xi}_j p_{ji})\left[\mu_j - \mu_i\right]^3 = 0$$

Assuming an MSM(2)-AR(p) case, non-steepness is obtained as:

$$E\left[\Delta\mu_t^3\right] = (\bar{\xi}_1 p_{12} - \bar{\xi}_2 p_{21})\left[\mu_2 - \mu_1\right]^3$$

Since $\bar{\xi}_1 / \overline{\xi_2} = p_{21} / p_{12}$, it implies $\bar{\xi}_1 p_{12} - \bar{\xi}_2 p_{21} = 0$ and $E\left[\Delta\mu_t^3\right] = 0$. Thus, a 2-regime Markov-switching model is always non-steep.

Clements and Krolzig (2003) devise a Wald test for the steepness, deepness, and sharpness asymmetries. These tests follow a standard asymptotic chi-squared distribution since they are conditional on the number of regimes.[11] They show via Monte Carlo experiments that their tests have good size and power properties.

Similar to the MSM(M)-AR(p) process, a MSI(M)-AR(p) process can also be represented as a sum of two independent process.

(7.6) $x_t - \mu_x = \mu_t + z_t$

Based on (7.6), μ_t is obtained as follows:

(7.7) $\mu_t = \alpha^{-1}(L)v_t$

where $v_t = \mu(s_t) - \overline{\mu} = \sum_{m=1}^{M} \mu_m (\xi_{mt} - \overline{\xi}_{m)}$ and $\alpha(L)(x_t - \mu_x) = v_t + z_t$. The Wald tests for deepness and steepness also can be constructed for the skewness of v_t and Δv_t .

Asymmetric behaviour can come either from the model's propagation mechanism or from its innovation. Hence, it is important to examine the null hypothesis relating to the innovation ($\sigma_1^2 = \sigma_2^2$) before one employs the formal asymmetry test. Clements and Krolzig (2003) show that regime-dependent heteroscedasticity has a significant influence on the results based on non-parametric and parametric tests. Moreover, a likelihood ratio test can be applied to examine regime-dependent heteroscedasticity.

(7.8) $$LR = 2(\ln L(\tilde{\lambda}) - \ln L(\tilde{\lambda}_0))$$

$\tilde{\lambda}$ and $\tilde{\lambda}_0$ denote the arguments of log-likelihood functions for a regime-dependent heteroscedasticity and a regime invariant variance MS(M)-AR(p) model, respectively. LR has an asymptotic χ^2 distribution with r degree of freedom.

7.3 The regime switching and asymmetric behaviour of job flows

In this Section we investigate the cyclical behaviour of job creation and destruction in the manufacturing, service and construction sectors in Taiwan prior to exploring whether monetary policy shocks are responsible for cyclical asymmetries in job creation or destruction. The initial aim is to establish whether there is evidence of "asymmetries" in the regime switching behaviour of job creation and destruction. We initially report the model selection based on ARMA representations.[12] A Markov-switching autoregression (MS-AR) model is then employed to examine the cyclical behaviour of the sectoral job creation and destruction rates. The present section focuses on regime-switches in the behaviour of changes in job creation and destruction during and after periods of recession. Finally, we report the results of non-parametric and parametric asymmetry tests for job creation and job destruction.

7.3.1 The model selection based on ARMA representations

Krolzig (1997) outlines a strategy for simultaneously selecting the state dimension M of the Markov chain and the order p of the autoregression. This involves the use of model selection procedures for the order of a univariate autoregressive moving average (ARMA) model. This approach is based on the vector autoregressive moving average (VARMA) representation theorems for MSI(M)-AR(p) and MSM(M)-AR(p) which indicate that an ARMA structure in the autocovariance function may reveal the characteristics of a data generating MS-AR process. These representation theorems offer guidance on the maximal orders of MSI(M)-AR(p) and MSM(M)-AR(p) formulations.

The results of the model selection criteria for job flow rates are listed in Appendix A. Following the suggestion of Krolzig (1997), the Akaike information criterion (AIC) and the Schwarz criterion (SC) are employed to decide the appropriate order of ARMA (p^*, q^*). However, the AIC and SC generally recommend different ARMA orders for job creation and destruction, only concurring for the job creation rate in the construction sector.

For the six variables, the AIC suggests a higher order ARMA process as compared to the SC. For example, the AIC suggests an ARMA(6,6) for the job creation rate in the manufacturing sector, while the SC indicates an ARMA(3,2). The explanation is that the SC imposes a greater penalty on additional regressors than does the AIC. Furthermore, the AIC indicates that the manufacturing job creation rate is best represented as an ARMA(6,6) which corresponds to MSI(7)-AR(0) and MSM(7)-AR(0) processes based on the ARMA representation theorems. In other words, the job creation rate in the manufacturing sector is best characterised as a hidden order Markov model with seven regimes in either the intercept or mean term. Similar results are also found for the job destruction rate in the service sector. The Markov switching model with seven regimes in either the intercept or mean term, however, does not provide a sound characterisation of the regime switching behaviour of the job creation rate in the manufacturing sector.[13] As a result, the AIC provides little guidance for the selection of regime (*M*) or autoregressive orders (*p*) for the job creation rate in the manufacturing sector.

Table 7.1 MSI(M)-AR(p) and MSM(M)-AR(p) selection

Sector	Variable	ARMA(p*,q*)	MSI(M)-AR(p)	MSM(M)-AR(p)
Manufacturing	Job creation	3,2	MSI(3)-AR(1)	MSM(2)-AR(2) MSM(3)-AR(1)
	Job destruction	4,2	MSI(3)-AR(2)	
Service	Job creation	3,2	MSI(3)-AR(1)	MSM(2)-AR(2) MSM(3)-AR(1)
	Job destruction	2,2	MSI(3)-AR(0)	MSM(3)-AR(0)
Construction	Job creation	5,2	MSI(3)-AR(3)	
	Job destruction	2,2	MSI(3)-AR(0)	MSM(3)-AR(0)

In contrast, using the SC for all variables leads to a feasible choice of the resulting Markov switching models. Since a MS-AR model with many (for example, seven) regimes becomes computationally demanding and unattractive (Krolzig, 1997), we consider the most parsimonious MSI(M)-AR(*p*) and MSM(M)-AR(*p*) specifications based on the SC. The proposed MSI(M)-AR(*p*) and MSM(M)-AR(*p*) specifications for the six variables are summarised in Table 7.1.

Following Krolzig (1997), the models indicated by ARMA representation theorems are useful for the estimation of more general MS models. In the next step, we focus on whether the various Markov switching models can capture the business cycle turning points which are defined by dates provided by the Council for Economic Planning and Development (CEPD).

Krolzig (1997) recommends using a Markov switching model with an intercept term (MSI) when the regime switching behaviour is assumed to follow a smooth path. In contrast, if the regime switching behaviour is assumed to be abrupt, then a MSM model is the preferred specification. In practice, we find that our six variables experience few abrupt changes and thus, a MSI-AR model with three regimes is chosen as the preferred specification for both job creation and destruction rates across the three sectors.

Although the results shown in Table 7.1 suggest that a MSI(3)-AR(*p*) is the preferred specification, diagnostic statistics (across various MSI(3)-AR(*p*) models) are used to determine which order of autoregression (p) is optimal.[14] For the manufacturing sector, we find that a MSI(3)-AR(1) specification has superior statistical properties based on its log-likelihood function as well as its relative ability to characterise the sector's cyclical job creation behaviour. Similar results are found for other variables[15], except that a lag length of 2 is preferred for the job creation rate in the construction sector.

We next test the assumption of homoskedasticity against the alternative of regime-dependent heteroskedasticity. The standard likelihood ratio test that asymptotically follows a χ^2 (r)-distribution with r degrees of freedom is employed. The results in Table 7.2 show the null hypothesis of homoscedastic errors is rejected for our six variables. Hence, a Markov-switching autoregression with a heteroscedastic errors model – the MSIH(M)-AR(p) - is employed for job creation and destruction rates in the three sectors.

Table 7.2 Linearity test and regime-dependent heteroscedasticity test

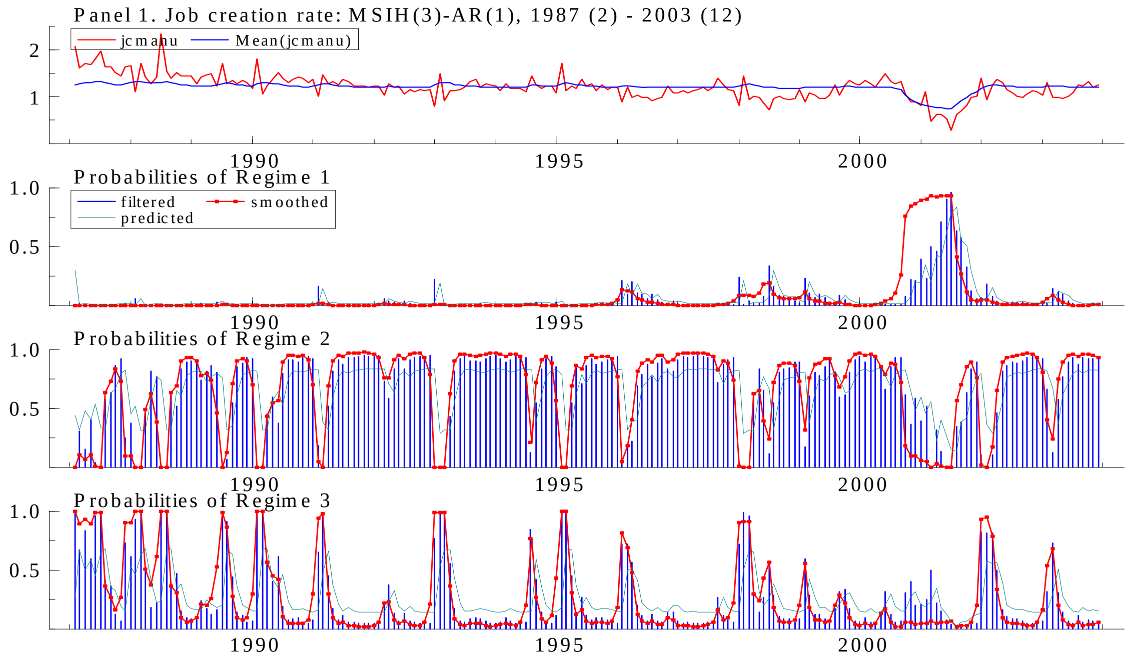
Sector \ Test	Manufacturing		Service		Construction	
	JC	JD	JC	JD	JC	JD
Linearity test[a]	36.98**	42.38**	26.32**	71**	35.04**	34.4**
Heteroscedasticity errors test[b]	35.18**	13.6**	16.06**	14.22**	26.52**	11.68*

Notes: [a] The likelihood ratio test for the null hypothesis of a linear autoregression against the alternative of a Markov-switching autoregression model.
[b] The likelihood ratio test for the null hypothesis for $\sigma_1^2 = \sigma_2^2$.
$\chi^2_{0.95}(4) = 9.4877$, $\chi^2_{0.99}(4) = 13.2767$
* indicates rejection of null hypothesis at 5%. ** indicate rejection of null hypothesis at 1%.

7.3.2 The empirical results from the MS models

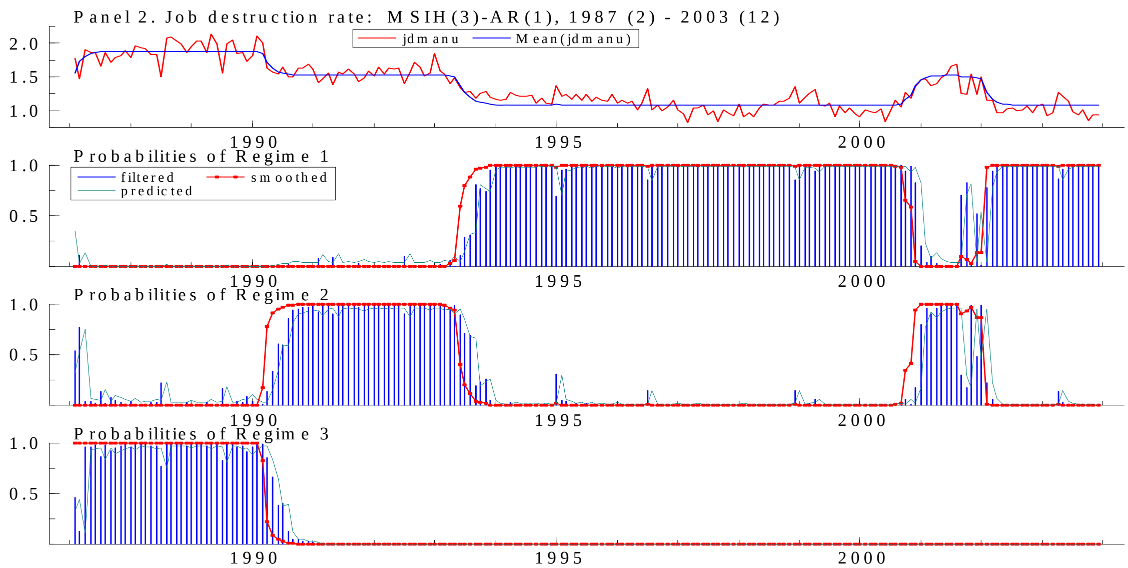
As shown in the top panel of Figures 7.2 to 7.4, the MS(M)-AR(q), is able to track the turning points for the job creation and destruction rates in the manufacturing, service and construction sectors, especially during the 2001 recession (December 2000 to March 2002). The three regimes in Figures 7.2a, 7.3a and 7.4a corresponding to job creation are identified as low growth (regime 1), moderate growth (regime 2), and high growth (regime 3); while the three regimes in Figures 7.2b, 7.3b and 7.4b are classified as low (regime 1), moderate (regime 2), and high (regime 3) of job destruction, respectively.

.Figure 7.2a Cyclical behaviour of the job creation rate in the manufacturing sector.



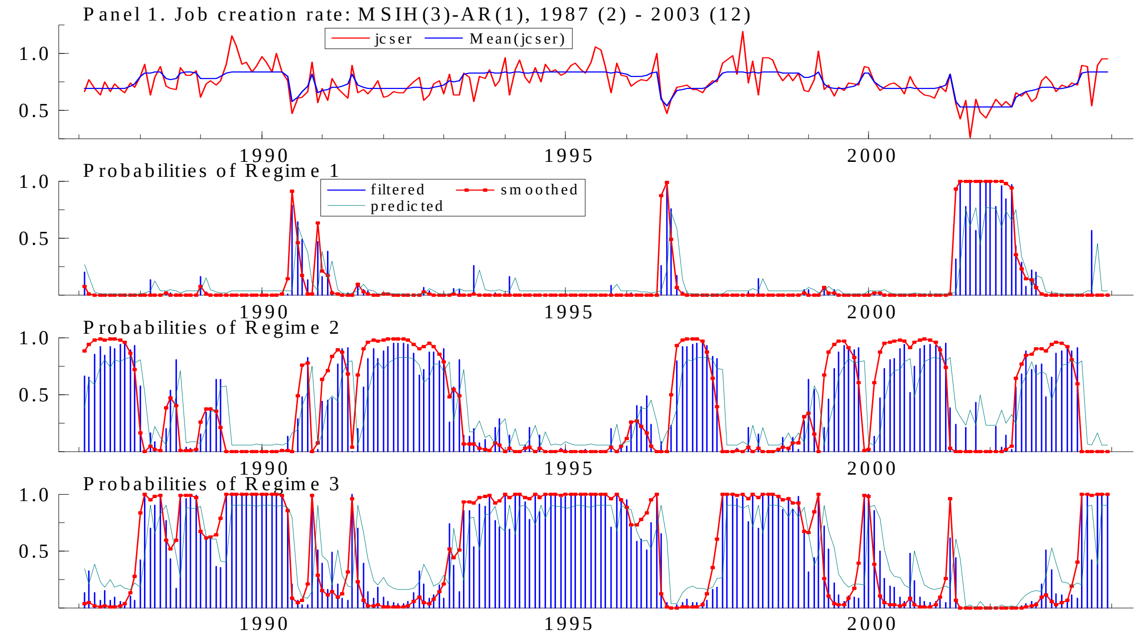
Notes: The top panel displays the actual and fitted values for job creation. The fitted values are produced by Maximum Likelihood estimation (see Chapter 6). The vertical axis in the top panel represents the rate of job creation (percent). The lower three panels record the filtered probabilities (the bases) and the smoothed probabilities for the 'low growth', 'moderate growth' and 'high growth' regimes, respectively.

Figure 7.2b Cyclical behaviour of the job destruction rate in the manufacturing sector.



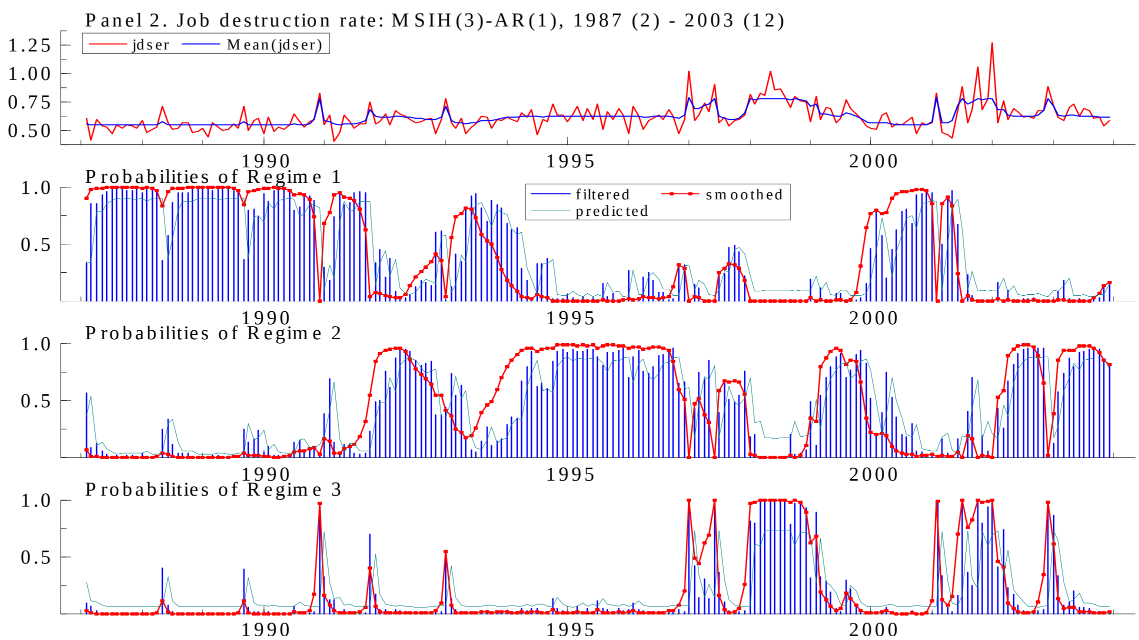
Notes: The top panel displays the actual and fitted values for job destruction. The vertical axis in the top panel represents the rate of job destruction (percent).The lower three panels record the filtered probabilities (the bases) and the smoothed probabilities for the 'low', 'moderate' and 'high' regimes of job destruction, respectively.

Figure 7.3a Cyclical behaviour of the job creation rate in the service sector.



Notes: See Figure 7.2a.

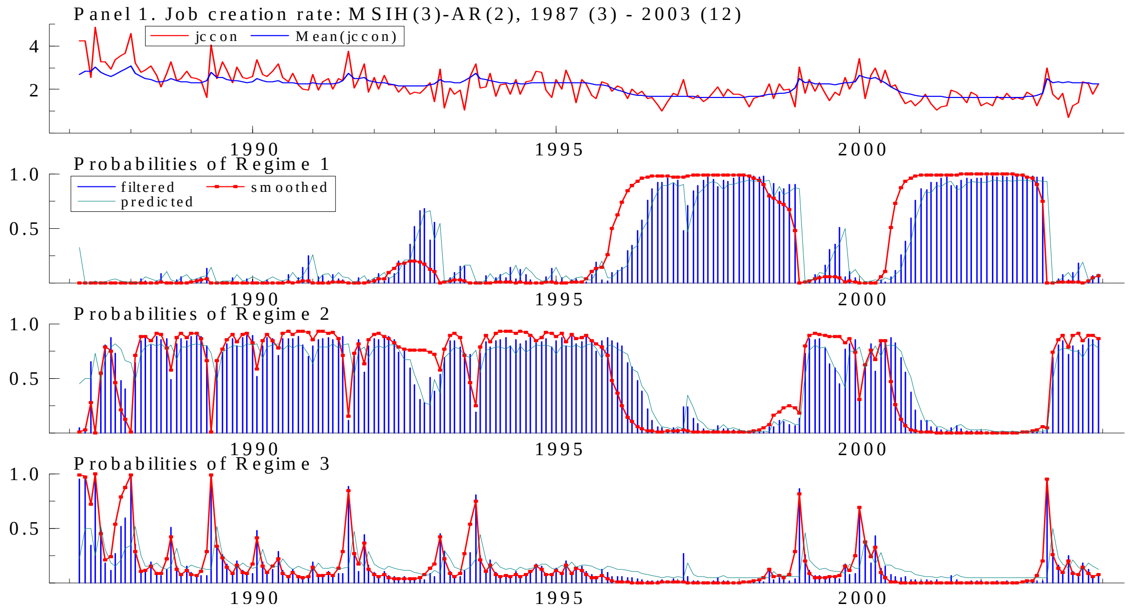
Figure 7.3b Cyclical behaviour of the job destruction rate in the service sector.



Notes: See Figure 7.2b.

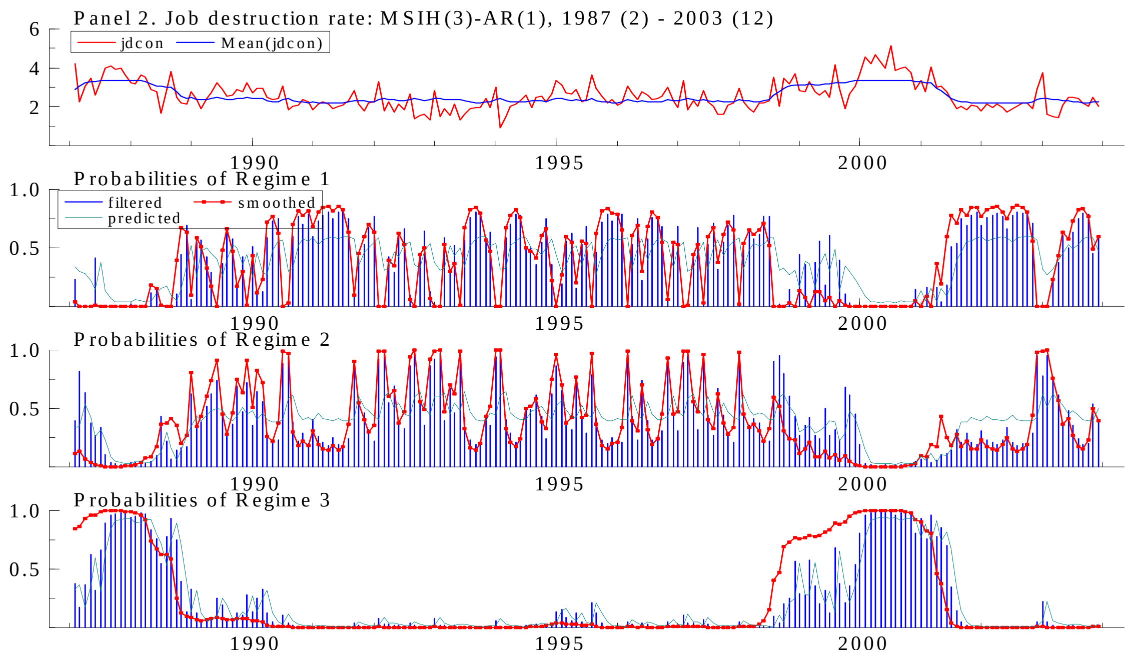
.

Figure 7.4a Cyclical behaviour of the job creation rate in the construction sector.



Notes: See Figure 7.2a.

Figure 7.4b Cyclical behaviour of the job destruction rate in the construction sector.



Notes: See Figure 7.2b.

Of interest is the significantly different regime switching behaviour of the job creation rates across the manufacturing, service and construction sectors. While job creation in the manufacturing sector mainly experienced the moderate growth phase with occasional high growth phases during the period 1987-2000, job creation in the construction sector underwent moderate growth with a long period of low growth (1996-1999). In contrast, job creation in the service sector continued its systematic pattern of moderate increase with a high increase phase until the 2001 recession period (December 2000 to March 2002).

Another interesting result from Figures 7.2b, 7.3b and 7.4b is that the job destruction also exhibits different patterns of regime switching behaviour across the three sectors. For example, job destruction in the manufacturing sector was high then moderate before switching to a low phase in mid-1993. Job destruction in the service sector was low for a long period before 1992 and then moderate with occasional high spikes during the period 1992-2000. In contrast, the job destruction in the construction sector was high before assuming an indented[16] pattern up until the early stages of the recession.

Table 7.3 reports the estimation results for our six variables based on MSIH(M)-AR(p) models.[17] The results show that the intercept terms for the three regimes are statistically significant at the 1 per cent level. Based on the value of the maximized likelihood function[18], the linearity tests consistently rejected the null of linearity. The durations of the different job creation regimes for the three sectors reveal that the service sector displays considerably more inertia than the other two sectors. Moreover, high increase phases in manufacturing average 3 months which are longer than those in the construction sector with an average of around 2 months. By contrast, the high increase phases in the service sector were estimated to last around 10 months. This feature corresponds to the finding in Chapter 2 that the Service sectors, such as Wholesale, Social Service and Industrial Service, created the most jobs over the period from 1991 to 2001.

Table 7.3 also shows that the job destruction rates in the manufacturing sector are more persistent than those prevailing in the service and construction sectors. For manufacturing the average low job destruction phase is around 97 months, whereas for the service and construction sectors, the phases are typically shorter, with an average duration of around 12 and 3 months, respectively. This finding corresponds to the Figure 7.2b which shows that the manufacturing sector experienced a persistent low job destruction phase during the period 1994-2000.

Table 7.3 MS-AR model results for job creation and destruction, 1987:01-2003:12.

	Manufacturing		Service		Construction	
	Job creation	Job destruction	Job creation	Job destruction	Job creation	Job destruction
	MSIH(3)-AR(1)	MSIH(3)-AR(1)	MSIH(3)-AR(1)	MSIH(3)-AR(1)	MSIH(3)-AR(2)	MSIH(3)-AR(1)
Intercept (regime1)	0.2429(2.15)*	0.5916(8.47)*	0.4645(8.59)*	0.5771(14.39)*	0.8497(5.85)*	1.2133(7.48)*
Intercept (regime2)	0.4154(6.62)*	0.8313(8.44)*	0.6094(11.35)*	0.6558(13.31)*	1.1314(5.14)*	1.3720(7.09)*
Intercept (regime3)	0.4656(5.11)*	1.0232(8.38)*	0.7376(10.65)*	0.8194(11.29)*	1.6715(2.19)*	1.8959(6.83)*
AR(-1)	0.6542(12.66)*	0.4548(7.23)*	0.1171(1.53)**	-0.0546(-0.79)**	0.2030(2.69)*	0.4369(5.51)*
AR(-2)					0.2822(4.08)*	
Transition Probabilities						
p11	0.8686	0.9897	0.7697	0.9162	0.9608	0.6595
p12	0.1312	0.0103	0.2294	0.0239	4.30E-05	0.3348
p13	0.0002	2.69E-09	0.0009	0.0599	0.0391	0.0057
p21	0.0129	0.0406	0.0013	0.0323	0.0248	0.3324
p22	0.8686	0.9594	0.8666	0.917	0.8707	0.6514
p23	0.1185	1.30E-06	0.1321	0.0506	0.1045	0.0162
p31	0.0002	6.62E-11	0.039	0.0964	1.05E-09	0.0309
p32	0.3187	0.0255	0.0581	0.1681	0.4812	0.0195
p33	0.6811	0.9745	0.9029	0.7356	0.5188	0.9496
Probability of regime1	0.0675	0.7971	0.0911	0.3731	0.3329	0.4142
Probability of regime2	0.6799	0.2029	0.3847	0.4552	0.5258	0.4078
Probability of regime3	0.2526	0	0.5242	0.1717	0.1412	0.178
Duration of regime 1 (months)	7.61	96.67	4.34	11.94	25.52	2.94
Duration of regime 2 (months)	7.61	24.61	7.5	12.05	7.74	2.87
Duration of regime 3 (months)	3.14	39.2	10.3	3.78	2.08	19.83
Obs in regime 1	13.5	111.9	18.6	80.8	66.2	77.9
Obs in regime 2	137	52.8	81.2	87	106.4	76.4
Obs in regime 3	52.6	38.2	103.1	35.2	29.3	48.7
Log likelihood	69.15	134.25	164.49	199.02	-138.85	-150.49
Linearity test	72*	56*	42*	87*	35*	46*

Notes: * and ** represent statistical significance at 1% and 5%, respectively. The t-statistics are in parentheses next to coefficient estimates.

The dynamics of regime switching behaviour in Figures 7.2, 7.3 and 7.4 and the empirical results in Table 7.3 reveal a crucial feature that the manufacturing, service and construction sectors underwent different restructuring processes over the period from 1987 to 2003. The possible explanation is that labour-intensive manufacturing such as the textile and plastic products industries continued to be transferred westward to Mainland China. As these industries mature with gradual decreases in technological advantage, they are replaced by new high technology industries such as semi-conductor industries and other information and electronics industries, which sustain job creation in the manufacturing sector (Yuan *et al*, 2006). As we saw in Chapter 2, Taiwan has progressively transformed its industrial structure which has seen a reduced reliance on the industrial sector[19] and an increasing importance of the services sector. By 1988, the services sector was employing more people than the manufacturing sector. By 2005, about 58.27 percent of Taiwan's 9.94 million workers were employed in the service sector. In contrast, the construction sector was experiencing a period of 'prolonged economic depression' after the deep contraction in 1987-88 (Chen, 1997). Figure 7.4 shows that the construction sector struggled to achieve high growth after 1987-88. Consistent with Chen (1997), our results suggest that the 'depression' in the construction sector was accompanied by a long and stable period of job destruction and a long period low growth of job creation.

7.3.3 The asymmetry test

Table 7.4 reports the results of the non-parametric (NP) and the more formal (parametric) asymmetry (MS) tests, which are based on the MSIH (*M*)-AR (*p*) models. There are two main findings. First, there is a significant difference between the non-parametric and MS-AR model-based tests. For example, the MS model-based test shows that the job destruction rate in the manufacturing sector displays positive skewness (steepness of expansion). However, the non-parametric test fails to reject the hypothesis of non-steepness. The reason for this discrepancy lies in the fact that the presence of heteroscedasticity can influence the skewness of the unconditional distribution of x_t and the MS-AR model based test catches the asymmetric behaviour that comes from the component of the Markov-chain.[20] Second, using the MS-AR model test, we find evidence of positive skewness (steepness of expansion) in the job destruction rate in the manufacturing sector and the negative skewness (steepness of contraction) in the job creation rate in the service sector. Moreover, evidence of sharpness, which results from a rejection of the null hypothesis of $P_{21} = P_{23}$, is found in the job destruction rate in the construction sector. The likely reason for this finding is that the job destruction in the construction sector is more likely to move from moderate to low rather than moving from moderate to high.

Table 7.4 Tests for asymmetries for the job creation and destruction

	Manufacturing sector			Service sector			Construction sector		
	Job creation			Job creation			Job creation		
Test	Sign	Statistic value	p value	Sign	Statistic value	p value	Sign	Statistic value	p value
MS:Sharpness		2.5897	0.46		3.9867	0.26		0.8241	0.84
$P_{12}=p_{32}$		0.9525	0.33		2.3616	0.12		0.0254	0.87
$P_{13}=p_{31}$		0.0001	0.99		0.1525	0.70		0.0013	0.97
$P_{21}=p_{23}$		2.4742	0.12		1.3399	0.25		0.8049	0.37
MS:Deepness	-	0.1739	0.68	-	0.1872	0.67	+	0.0303	0.86
MS:Steepness	-	0.3790	0.54	-	5.3350	0.02**	+	0.2132	0.64
NP:Deepness	+	1.9153	0.16	+	0.7757	0.38	+	28.5927	0**
NP:Steepness	+	0.7104	0.4	-	3.0028	0.08*	+	0.8443	0.36
	Job destruction			Job destruction			Job destruction		
MS:Sharpness		1.5367	0.67		3.0081	0.39		9.0033	0.03*
$P_{12}=p_{32}$		0.3788	0.54		2.2604	0.13		2.7162	0.09
$P_{13}=p_{31}$		0.0212	0.88		0.2836	0.59		0.3749	0.54
$P_{21}=p_{23}$		0.1259	0.72		0.0670	0.8		4.3425	0.04*
MS:Deepness	+	0.2645	0.61	+	0.2305	0.63	+	0.1979	0.65
MS:Steepness	+	5.9658	0.01*	-	3.5697	0.06*	-	1.5682	0.21
NP:Deepness	+	10.232	0.001**	+	96.8434	0**	+	21.8972	0**
NP:Steepness	+	1.7185	0.19	+	9.9581	0.002**	-	2.8182	0.21

Note: The NP and MS test statistics are χ^2 (1) under the null of symmetry. A positive (negative) value of "Sign" flags positive (negative) skewness. *Significance at the 10% level. **Significance at the 5 % level.

In summary, despite the inconsistent results derived from the non-parametric tests and the more formal (parametric) asymmetry (MS) tests, we tentatively conclude that there is evidence of steepness in the job destruction rate for the manufacturing sector and the job creation rate in the service sector and that sharpness is revealed for the job destruction rate in the construction sector. The evidence of asymmetries in job creation and destruction across the industry composition in Taiwan then motivates us to investigate whether there is any connection with changes in monetary policy.

7.4 Can monetary policy explain asymmetries in job flows?

7.4.1 The transmission of monetary policy on job flows

A number of empirical studies have confirmed the connection between monetary policy and economic activity, which is commonly referred to as the transmission mechanism (for example, Bernanke and Blinder, 1992; Bernanke and Boivin, 2003; Florio, 2005). In contrast to previous studies (Taylor, 1995; Bonser *et al.*, 1998; Basile and Joyce, 2001; Dickinson and Liu, 2007), which emphasise the connection between monetary policy and aggregate output, there are a few theoretical models that have been developed to explain the impact of monetary policy on job flows (Garibaldi, 1997; Andolfatto *et al.*, 2004).

Garibaldi (1997) proposes the interest rate channel (based on what is known as "matching theory") to explain how monetary policy effects are transmitted to job creation and job destruction.[21] Matching theory assumes that a fixed number of risk-neutral workers inhabit an economy and each worker is posited as either employed or unemployed and looking for a job. Jobs are occupied or vacant in each firm. Production is undertaken with an irreversible technology. Each firm is assumed to produce a homogenous product at different productivity levels. In equilibrium, each firm endogenously selects an optimum productivity level, where the marginal job is unprofitable. Interest costs affect the cost of holding inventories, which are often financed by bank loans. Importantly, higher interest cost makes it more likely that they will reduce employment or hours worked. In contrast, when the interest rate is falling, it is cheaper for firms to finance investment in new plant and they are more likely to expand their employment. As a result, each firm adjusts its employment level in order to achieve its optimum productivity level.

In matching theory, job creation is the result of a costly and time consuming process of matching vacancies to job seekers. In contrast, job destruction occurs immediately once the reservation productivity falls below the optimum level. Hence, Garibaldi (1997) suggests the job creation and destruction react asymmetrically to the interest rate changes.

Andolfatto *et al.* (2004) propose an equilibrium model that characterises information frictions in the money market and search frictions in the labour market to explain how monetary policy influences the labour market. The information friction occurs because enterprises do not realise that monetary policy has changed. With incomplete information, enterprises slowly adjust the employment level. Furthermore, Andolfatto *et al.* (2004) emphasise that there are search frictions in the labour market. The search frictions occur because imperfect information leads to the unemployed taking time to find their best job opportunity (Stigler, 1961; Phelps, 1970; Pissarides, 1985). On the other hand, only enterprises with job vacancies are actively engaged in search. As a result, job creation is the product of the search intensity of workers (unemployed) and enterprises (vacancies).

Despite the fact that most central banks, including the Central Bank of Taiwan (CBT) conduct monetary policy by manipulating the short-term interest rates, Andolfatto *et al.* (2004) use the stock of money as the monetary policy proxy. They find that job creation reacts very gradually to monetary policy shocks which they interpret as being the consequence of incomplete information on the part of enterprises and the time consuming search process for job seekers.[22] However, Andolfatto *et al.* (2004) is silent with regard to the impact of monetary policy on job destruction.

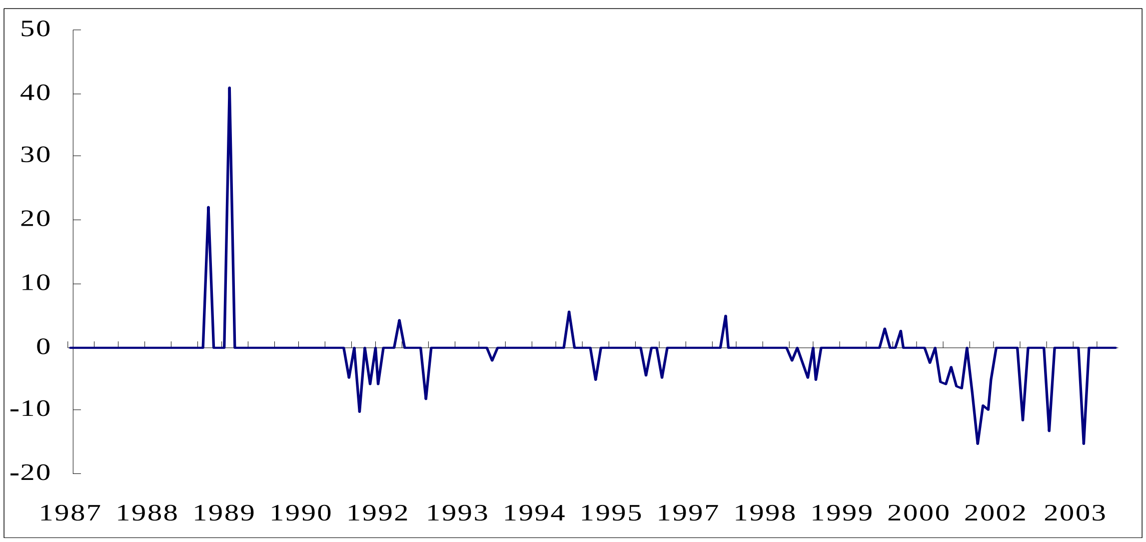
One limitation in both Garibaldi (1997) and Andolfatto *et al.* (2004) is that they assume the representative agents behaviour identically and are silent about the heterogenous behaviour of job creation and destruction at the plant level.[23] Despite this limitation, the theoretical models used by Garibaldi (1997) and Andolfatto *et al.* (2004) have advanced the debate about how monetary policy transmits shocks to the processes of job creation and destruction. Based on the matching theory in Garibaldi (1997) and the search theory in Andolfatto *et al.* (2004), we propose the hypothesis that the change of monetary policy caused the asymmetric behaviour of job creation and destruction during the Asian financial crisis and the 2001 recession. In order to achieve the optimum productivity level, enterprises react immediately to negative shocks with a sharp increase in job destruction and a sharp decrease in job creation. In contrast, the time consuming search and matching processes lead to a slow adjustment in job creation and destruction for enterprises which respond to positive shocks. The positive and negative shocks might work together to impart a cyclical asymmetry to job creation and destruction.[24] In the next step, we examine this hypothesis by employing the Markov-switching model with an exogenous variable (the change of monetary policy).[25]

.

7.4.2 The asymmetry tests based on MSIH(M)-ARX(p) model

In the introduction to this Chapter, we noted that economists now consider that monetary policy is conducted largely by varying short-term interest rates, in contradistinction to the typical textbook models which characterise the central bank as seeking to control the money supply. In this section we thus use the discount rate as the monetary policy instrument of the CBT in Taiwan.

Figure 7.5 The monthly percentage change of the discount rate, Taiwan, 1987-2003



Source: Taiwan Economic Data Centre, 2004.

Notes: The monthly discount rate is measured as a percentage change. For example, the discount rate increased from 5.5% at July to 7.75% at August 1989. This represents a 41 per cent change of the discount rate over this period.

Figure 7.5 shows the time series pattern of changes of the discount rate. The time series data is sourced from AREMOS (Advanced REtrieval MOdeling System). It is clear that the central bank frequently adjusted the discount rate during the periods 1990-1992 and 2000-2002.

Table 7.5 Results of asymmetry test conditioned on monetary policy

	Job destruction in the manufacturing sector			Job destruction plus discount rate		
Test	sign	Statistic	p-value	sign	Statistic	p-value
Nonsharpness		1.54	0.67		0.49	0.93
$p_{12}=p_{32}$		0.38	0.54		0.18	0.67
$p_{13}=p_{31}$		0.02	0.88		0.00	0.97
$p_{21}=p_{23}$		0.13	0.72		0.43	0.51
NonDeepness	+	0.26	0.61	+	0.12	0.73
NonSteepness	+	5.97	0.01*	+	0.01	0.90
	Job creation in the service sector			Job creation plus discount rate		
Test	sign	Statistic	p-value	sign	Statistic	p-value
Nonsharpness		3.99	0.26		2.29	0.51
$p_{12}=p_{32}$		2.36	0.12		1.00	0.31
$p_{13}=p_{31}$		0.15	0.70		0.15	0.70
$p_{21}=p_{23}$		1.34	0.25		0.81	0.37
NonDeepness	-	0.19	0.67	-	0.02	0.89
NonSteepness	-	5.34	0.02*	-	0.81	0.37
	Job destruction in the construction sector			Job destruction plus discount rate		
Test	sign	Statistic	p-value	sign	Statistic	p-value
Nonsharpness		9.00	0.03*		4.84	0.18
$p_{12}=p_{32}$		2.72	0.09		3.26	0.07
$p_{13}=p_{31}$		0.37	0.54		0.01	0.98
$p_{21}=p_{23}$		4.34	0.04*		0.75	0.39
NonDeepness	+	0.20	0.65	+	0.47	0.49
NonSteepness	-	1.57	0.21	-	0.96	0.33

Notes: * indicate rejection of null hypothesis at 5 per cent.

Table 7.5 reports the parametric test results conditioned on the discount rate. Based on the formal parametric test in section 7.3, evidence of steepness is found in the job destruction rate in the manufacturing sector and the job creation rate in the service sector and sharpness is revealed for the job destruction rate in the construction sector. Interestingly, when the percentage change in the discount rate is included as an exogenous variable, the null hypothesis of non-steepness for the job destruction rate in the manufacturing sector and the job creation rate in the service sector cannot be rejected at the 1 per cent level. A similar finding is shown for the job destruction rate in the construction sector. The evidence is thus consistent with the hypothesis that monetary policy (the discount rate) is statistically associated with the asymmetric behaviour of some job creation and job destruction rates.

Figures 7.6 to 7.8 distinguish models according to whether or not the rates are conditioned on the discount rate. Importantly, these figures allow us to pinpoint when the asymmetric behaviour occurs in the job creation and destruction rates. Comparing the MSIH(M)-AR(p) and MSIH(M)-ARX(p) models, we find that steepness occurred in the manufacturing sector at the time when Regime 3 was switching to Regime 2 in 1990:03. Moreover, the steepness arose in the service sector during 1990:07-1991:07. Finally, in the construction sector, the discount rate helps to explain the finding that the probability of a switch from Regime 2 switch to Regime 1 (p_{21}) is higher than the probability of a switch from Regime 2 to Regime 3 (p_{23}) during the period 1990:09-1991:08 and 2001:06-2002:11. The timing of the asymmetric behaviour that is detected in the job creation and destruction rates is very interesting since it coincides with important economic episodes. The first date, within the period 1990-91, is linked to the collapse of the great Taiwanese bubble.[26] The second date which is associated with asymmetric behaviour in the construction sector coincided with the 2001 recession.

Figure 7.6 Time series pattern of different regimes of job destruction rates in the manufacturing sector: (1) with no exogenous variable; & (2) conditioned on discount rate.

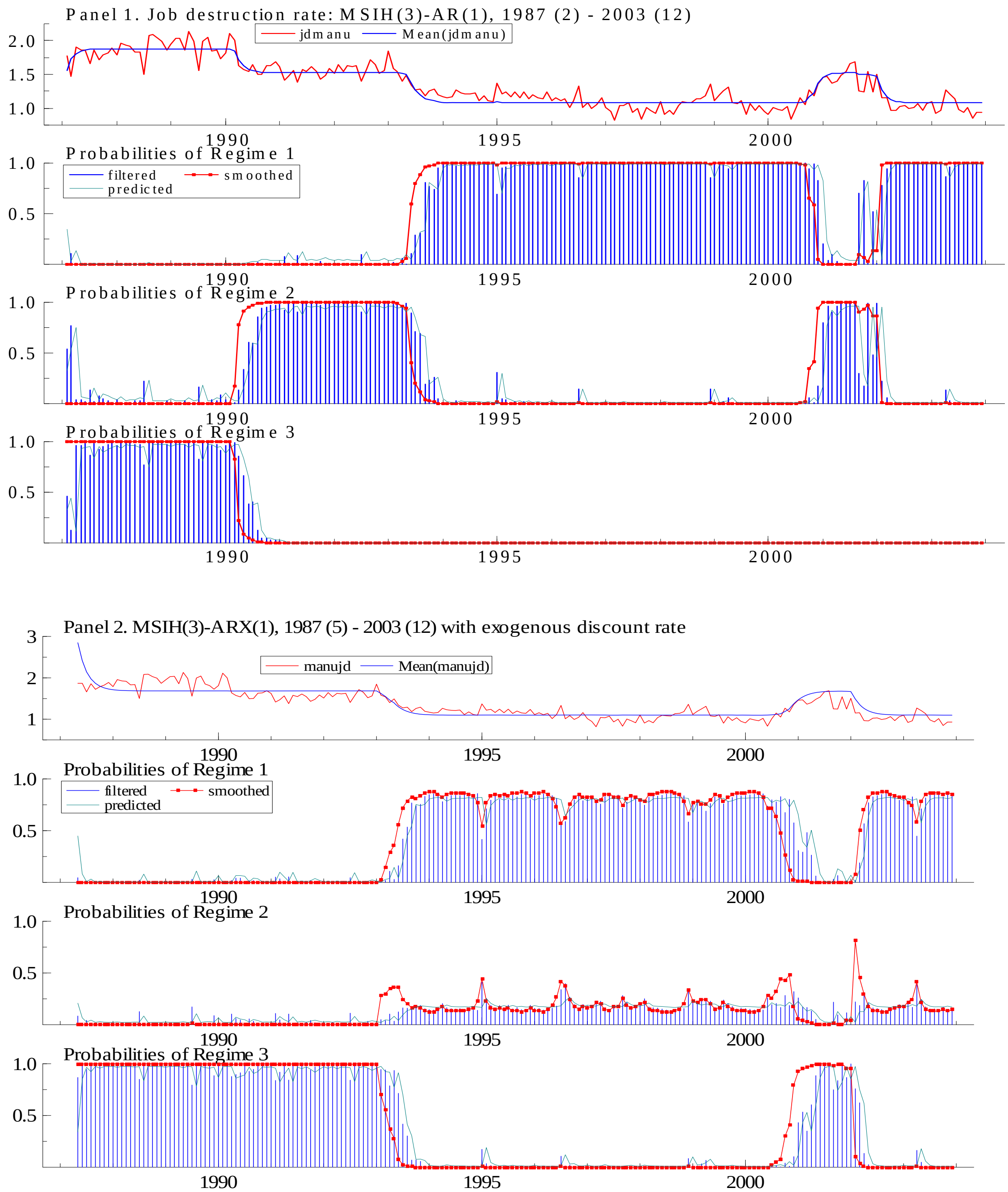


Figure 7.7 Time series pattern of different regimes of job creation rate in the service sector: (1) with no exogenous variable; & (2) conditioned on discount rate.

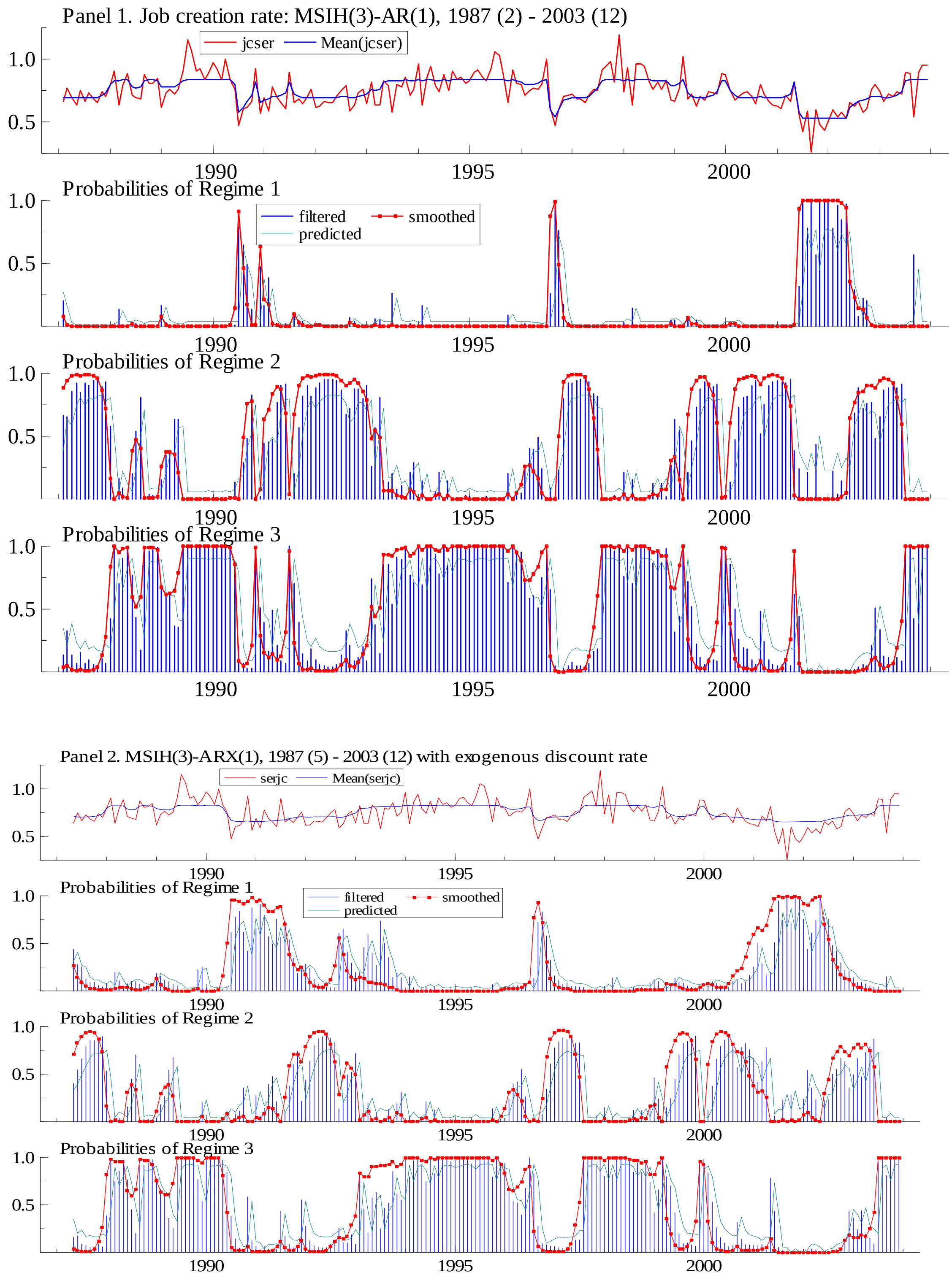
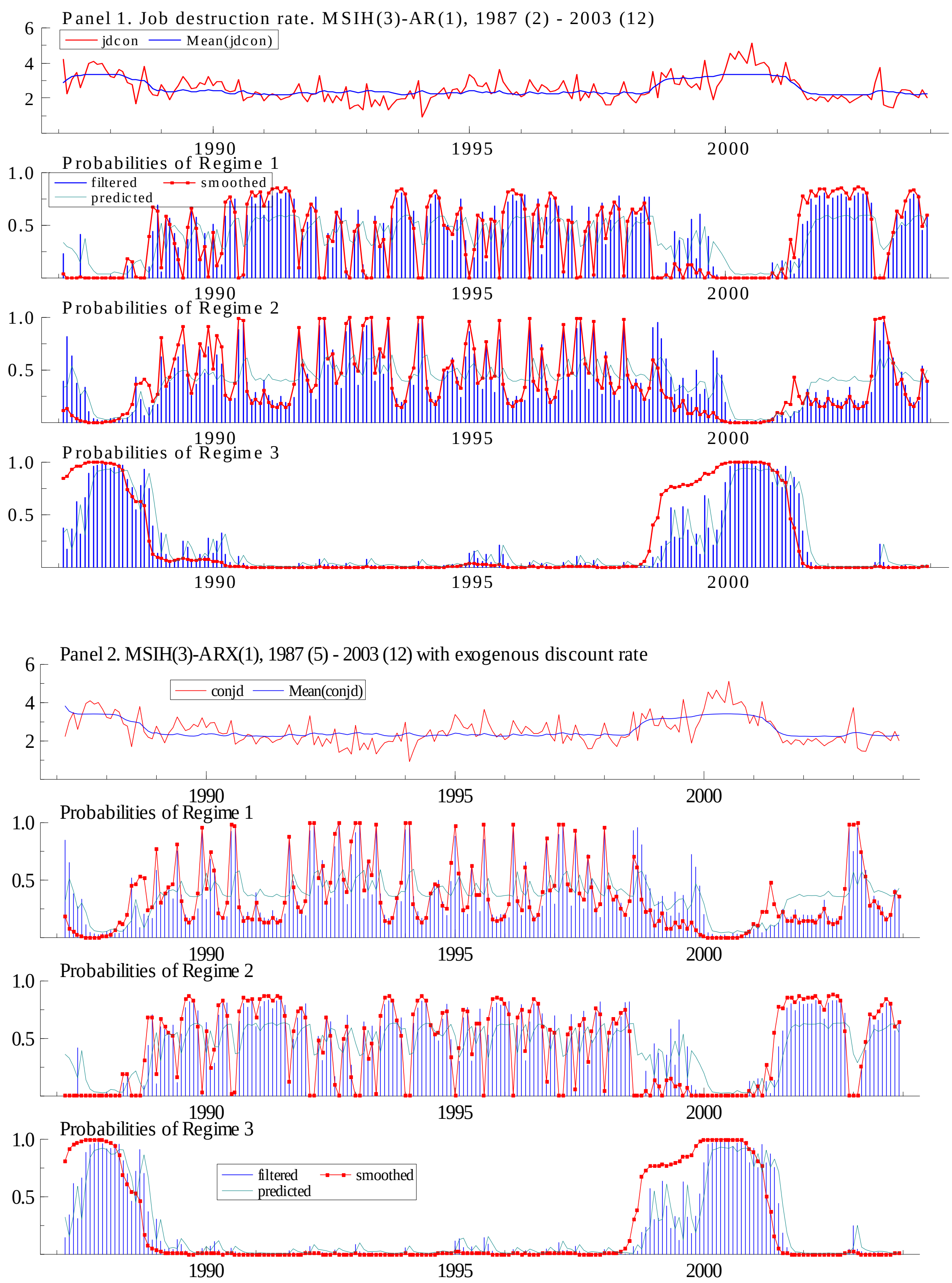


Figure 7.8 Time series pattern of different regimes of job destruction rate in the construction sector: (1) with no exogenous variable; & (2) conditioned on discount rate.



A crucial feature revealed from Figures 7.6 to 7.8 is that beneficial regime shifts in employment flows were generated by active monetary policy changes executed by the Taiwanese CBT. For example, after the Taiwanese CBT eased monetary policy in 1990 and 2001, the job destruction in the manufacturing sector switched from a high regime to a moderate regime. Similarly, job destruction in the construction sector switched from a moderate regime to a low phase. Further, job creation in the service sector changed from a low growth phase to a moderate growth regime.

The original motivation of this Section was to explore whether monetary policy can explain the asymmetric behaviour of job creation and destruction. We find that changes in policy, represented by changes in the discount rate, coincide with the asymmetric behaviour of job creation and destruction. This coincidence in time does not directly prove that monetary policy changes are responsible for variations in the rates of job creation and destruction. However, we found that beneficial regime shifts in job flows are associated in time with active monetary policy changes executed by the Taiwanese CBT. If the relations are causal then monetary policy has a significant influence on the cyclical behaviour of job creation and destruction which suggests that active monetary policy may be a useful tool to stimulate the labour market.

The efficacy of monetary policy in achieving these goals (full employment, steady economic growth, and stable prices), however, has been highly contested among economists (Taylor, 1993; William, 2000). The debate focuses on whether the economy is self-correcting in the face of exogenous supply and demand disturbances. Proponents of discretionary monetary policy suggest that government intervention can reduce the extent of economic downturns and improve overall economic welfare (Keynes, 1964; Clarida *et al.*, 1999; King and Plosser, 2005; Goodfriend, 2007). Those who oppose this view emphasise the primacy of the economy as a self-correcting mechanism and argue that government intervention now sows the seeds for a more serious contraction and higher inflation in the future (Friedman, 1968, 1969; Barro and Gordon, 1983a, 1983b).

The interest rate influence on the exchange rate is another possible way in which monetary policy changes may generate asymmetric behaviour in job flows. However, the causal relationship between the interest rate and the exchange rate is a controversial issue with evidence of the relationship being mixed. Park *et al.* (1999) and Brailsford *et al.* (2006) find that higher interest rates helped to support the exchange rates of South Korea, the Philippines and Thailand during the period of financial crisis. Moreover, Shiau (2003) finds that the exchange rate and interest rate Granger-caused each other in Taiwan during 1982-2001. In contrast, Kaminsky and Schmukler (1998) and Goldfajn and Baig (2002) find that higher interest rates were unable to stabilise foreign exchange markets in Indonesia and Malaysia in 1997 and early 1998.

If easing monetary policy forces domestic real interest rates to decrease, the domestic currency becomes less attractive relative to foreign currency deposits, thereby leading a depreciation of the dollar. The depreciation of the domestic currency will increase demand for Taiwanese exports and stimulate enterprises to create jobs. Several studies have explored the impact of the real exchange rate on gross job flows (Dekle, 1998; Klein *et al.*, 2003; Christopoulos, 2004; Haltiwanger *et al.*, 2004; Kim, 2005; Mitchell and Myers, 2007). In Australia, for example, Mitchell and Myers (2007) find that both job creation and destruction rates in the goods-producing sector exhibit a significant response to exchange rate fluctuations. Furthermore, the exchange rates have a negative impact on the job destruction rate in the trading-services sector.

The effectiveness of monetary policy in influencing job flows implies that contractionary monetary policy would be damaging to the labour market. This issue is important since the central bank attempts to keep inflation within a target range[27] and to curb overheating in a boom. Given the evidence that contractionary monetary policy decreases job creation and increases job destruction (Garibaldi, 1997; Andolfatto *et al.*, 2004), tight monetary policy should be executed with caution, whether it is designed to reduce inflation or to moderate output growth.

7.5 Conclusion

This Chapter has investigated the regime switching and asymmetric behaviour of job creation and destruction in the Taiwanese manufacturing, service, and construction sectors during the period 1987 to 2003. The seventeen year sample includes 3 full business cycles, and thus provides a good opportunity to investigate cyclical behaviour of job creation and destruction.

The first purpose of this Chapter was to examine whether active intervention of the Central Bank of Taiwan during the Asian financial crisis and 2001 recession has introduced asymmetric behaviour into the job creation and destruction rates. Using the MS-AR model-based test, we found evidence of positive steepness in the job destruction rate in the manufacturing sector and negative steepness of the job creation rate in the service sector. Moreover, evidence of sharpness is found in the job destruction rate in the construction sector. These results suggest that some phases of regime switching behaviour in these three sectors are different from the mirror image of the opposite phase (Sichel, 1993). The evidence of asymmetries in job creation and destruction across the three sectors in Taiwan motivates us to investigate whether there is any connection with monetary policy changes.

Using MSIH(M)-ARX(p) model with an exogenous variable which proxies monetary policy changes (the discount rate), we found that the discount rate can help to explain the asymmetric behaviour of job creation and destruction rates in all sectors. Importantly, we found that a lower discount rate stimulated beneficial regime shifts in job flows. For example, job destruction in the manufacturing sector switched from the high regime to the moderate regime after the Taiwanese CBT implemented an easy monetary policy in 1990 and 2001. Moreover, job creation in the service sector switched from a low growth regime to a moderate growth regime while the job destruction in the construction sector switched from a moderate regime to the low regime during this period. This coincidence in time does not directly prove the impact of monetary policy (the discount rate) on job creation and destruction. We do not deny the possibility that the easing of monetary policy was associated with other factors which could also have promoted the beneficial regime shifts. We thus tentatively conclude that discretionary monetary policy in Taiwan has a significant influence on the cyclical behaviour of job creation and destruction. The results suggest that monetary policy may be an efficient instrument in stimulating the labour market during periods of recession but should be executed with caution in fighting inflation and slowing economic growth in a boom.[28]

.

In the following chapter we study the cyclical behaviour of job creation and destruction at the regional level. Little is known about the behaviour of gross job flows at this spatial level particularly in the context of a newly industrialising economy (NIE), such as Taiwan.

Appendix A:

Table A.1 ARMA (p*,q*) Model Selection Criteria for Manufacturing Sector

Job Creation			Job Destruction		
(p,q)	AIC	SC	(p,q)	AIC	SC
1,1	-0.59	-0.54	1,1	-1.23	-1.18
1,2	-0.63	-0.57	1,2	-1.22	-1.16
1,3	-0.62	-0.54	1,3	-1.22	-1.14
1,4	-0.61	-0.52	1,4	-1.23	-1.13
1,5	-0.64	-0.52	1,5	-1.24	-1.12
1,6	-0.61	-0.48	1,6	-1.23	-1.10
2,1	-0.62	-0.56	2,1	-1.22	-1.16
2,2	-0.64	-0.56	2,2	-1.28	-1.20
2,3	-0.62	-0.52	2,3	-1.30	-1.20
2,4	-0.62	-0.51	2,4	-1.30	-1.19
2,5	-0.62	-0.49	2,5	-1.30	-1.17
2,6	-0.61	-0.46	2,6	-1.31	-1.17
3,1	-0.62	-0.54	3,1	-1.23	-1.15
3,2	-0.62	-0.58*	3,2	-1.29	-1.19
3,3	-0.61	-0.56	3,3	-1.29	-1.17
3,4	-0.68	-0.55	3,4	-1.32	-1.19
3,5	-0.67	-0.53	3,5	-1.29	-1.15
3,6	-0.60	-0.44	3,6	-1.28	-1.12
4,1	-0.63	-0.53	4,1	-1.26	-1.16
4,2	-0.62	-0.51	4,2	-1.26	-1.23*
4,3	-0.69	-0.56	4,3	-1.32	-1.19
4,4	-0.68	-0.53	4,4	-1.31	-1.16
4,5	-0.69	-0.53	4,5	-1.38*	-1.22
4,6	-0.68	-0.50	4,6	-1.34	-1.15
5,1	-0.63	-0.51	5,1	-1.25	-1.13
5,2	-0.62	-0.49	5,2	-1.25	-1.12
5,3	-0.69	-0.54	5,3	-1.33	-1.18
5,4	-0.68	-0.51	5,4	-1.33	-1.16
5,5	-0.65	-0.47	5,5	-1.32	-1.13
5,6	-0.64	-0.44	5,6	-1.35	-1.15
6,1	-0.62	-0.49	6,1	-1.30	-1.17
6,2	-0.70	-0.55	6,2	-1.36	-1.21
6,3	-0.68	-0.52	6,3	-1.31	-1.14
6,4	-0.70	-0.52	6,4	-1.29	-1.10
6,5	-0.75	-0.55	6,5	-1.38	-1.18
6,6	-0.76*	-0.53	6,6	-1.33	-1.11

Notes: * indicates lag order selected by the criterion.
AIC: Akaike information criterion;
SC: Schwarz information criterion.

Table A.2 ARMA (p*,q*) Model Selection Criteria for Service Sector

Job Creation			Job Destruction		
(p,q)	AIC	SC	(p,q)	AIC	SC
1,1	-1.50	-1.41	1,1	-1.66	-1.61
1,2	-1.49	-1.42	1,2	-1.65	-1.59
1,3	-1.48	-1.39	1,3	-1.66	-1.58
1,4	-1.48	-1.39	1,4	-1.65	-1.55
1,5	-1.48	-1.37	1,5	-1.65	-1.54
1,6	-1.47	-1.34	1,6	-1.70	-1.57
2,1	-1.48	-1.42	2,1	-1.65	-1.59
2,2	-1.47	-1.39	2,2	-1.71	-1.61*
2,3	-1.47	-1.37	2,3	-1.67	-1.57
2,4	-1.49	-1.38	2,4	-1.67	-1.55
2,5	-1.48	-1.35	2,5	-1.66	-1.53
2,6	-1.48	-1.33	2,6	-1.66	-1.51
3,1	-1.47	-1.39	3,1	-1.65	-1.57
3,2	-1.46	-1.45*	3,2	-1.68	-1.58
3,3	-1.52	-1.41	3,3	-1.68	-1.56
3,4	-1.50	-1.37	3,4	-1.67	-1.53
3,5	-1.50	-1.36	3,5	-1.66	-1.52
3,6	-1.50	-1.34	3,6	-1.65	-1.49
4,1	-1.47	-1.37	4,1	-1.64	-1.54
4,2	-1.46	-1.34	4,2	-1.67	-1.55
4,3	-1.51	-1.38	4,3	-1.66	-1.53
4,4	-1.51	-1.36	4,4	-1.65	-1.50
4,5	-1.50	-1.33	4,5	-1.65	-1.48
4,6	-1.49	-1.31	4,6	-1.69	-1.51
5,1	-1.45	-1.34	5,1	-1.64	-1.52
5,2	-1.45	-1.31	5,2	-1.71	-1.58
5,3	-1.44	-1.29	5,3	-1.70	-1.56
5,4	-1.48	-1.31	5,4	-1.65	-1.48
5,5	-1.49	-1.31	5,5	-1.65	-1.47
5,6	-1.64*	-1.44	5,6	-1.72	-1.52
6,1	-1.44	-1.31	6,1	-1.72	-1.58
6,2	-1.43	-1.28	6,2	-1.71	-1.56
6,3	-1.47	-1.30	6,3	-1.76	-1.59
6,4	-1.48	-1.30	6,4	-1.72	-1.54
6,5	-1.48	-1.28	6,5	-1.71	-1.52
6,6	-1.46	-1.24	6,6	-1.73*	-1.52

Notes: see Table A.1.

Table A.3 ARMA (p*,q*) Model Selection Criteria for Construction Sector

	Job Creation			Job Destruction	
(p,q)	AIC	SC	(p,q)	AIC	SC
1,1	1.42	1.48	1,1	1.66	1.71
1,2	1.43	1.49	1,2	1.67	1.74
1,3	1.43	1.51	1,3	1.67	1.75
1,4	1.39	1.48	1,4	1.67	1.76
1,5	1.40	1.51	1,5	1.69	1.80
1,6	1.36	1.49	1,6	1.68	1.81
2,1	1.42	1.49	2,1	1.61	1.69
2,2	1.43	1.52	2,2	1.62	1.68*
2,3	1.43	1.53	2,3	1.67	1.77
2,4	1.42	1.53	2,4	1.61	1.73
2,5	1.38	1.51	2,5	1.60	1.74
2,6	1.40	1.54	2,6	1.70	1.85
3,1	1.43	1.51	3,1	1.60	1.69
3,2	1.42	1.52	3,2	1.61	1.71
3,3	1.41	1.53	3,3	1.60	1.71
3,4	1.42	1.55	3,4	1.60	1.74
3,5	1.39	1.54	3,5	1.60	1.75
3,6	1.38	1.55	3,6	1.61	1.77
4,1	1.44	1.54	4,1	1.60	1.70
4,2	1.39	1.50	4,2	1.57	1.69
4,3	1.40	1.53	4,3	1.57	1.71
4,4	1.41	1.56	4,4	1.58	1.73
4,5	1.42	1.58	4,5	1.59	1.76
4,6	1.35	1.51	4,6	1.59	1.77
5,1	1.43	1.55	5,1	1.62	1.74
5,2	1.33*	1.47*	5,2	1.62	1.75
5,3	1.37	1.52	5,3	1.59	1.74
5,4	1.38	1.54	5,4	1.54	1.71
5,5	1.35	1.53	5,5	1.53*	1.72
5,6	1.37	1.57	5,6	1.54	1.74
6,1	1.36	1.49	6,1	1.62	1.75
6,2	1.37	1.52	6,2	1.63	1.78
6,3	1.36	1.53	6,3	1.60	1.76
6,4	1.37	1.55	6,4	1.54	1.72
6,5	1.39	1.59	6,5	1.54	1.74
6,6	1.40	1.62	6,6	1.55	1.76

Notes: see table A.1.

Notes:

---

[1] The main reasons for the 2001 recession were the global economic recession, dwindling domestic investment, and the adjustment of its domestic industrial structure (Taiwan New Economy Newsletter, 2002).

[2] On the other hand, the stock index dropped from a peak of 10066 at the end of July to 7313 at the end of October, 1997 (Statistical Yearbook of Taiwan, 1997). Meanwhile, the New Taiwan (NT) dollar deprecated by 14.25 per cent against US dollar.

[3] There are a number of contemporary debates about the operation of monetary policy, including (i) whether inflation targeting (IT) has led to monetary policy being the central policy instrument and fiscal policy being largely passive (Fullwiler, 2007; Chadha and Nolan, 2007) and (ii) whether IT has been able to reduce inflation and inflation volatility (Ball and Sheridan, 2003; Goncalves and Salles, 2008).

[4] There are other two explanations for the asymmetric behaviour of macroeconomic aggregates. First, large, discrete technological changes require the accumulation of infrastructural investment that endogenously generates asymmetric upswings and downswings in economic activity (Freeman *et al.*, 1999; Maliar and Maliar; 2004). Second, the type of shocks that occur at one stage of the business cycle may be quite different from those experienced at another stage of the business cycle (Bodman, 2001).

[5] Baudry and Koop (1993) propose a model in which an asymmetry can be generated at the average level of output if prices are adjusted quickly to an unexpected positive monetary shock but respond slowly to an unexpected negative monetary shock. De Long and Summers (1988) also present a model of different rates of price adjustment that generate asymmetry.

[6] See Chapter 6 for more details about the MS-ARX model.

[7] Calballero and Hammour (1996) also provide a similar idea and propose a creative destruction model with heterogeneous technologies. Furthermore, some empirical evidences of heterogeneous technologies have been provided by Goolsbee (199, 2004).

[8] The macroeconomic variables include industrial production, capacity utilization, employment, unemployment rate, housing rate, housing starts, personal income, consumption and durable-goods orders.

[9] In the recent literature on monetary policy analysis, there have been many studies emphasised the distinction between instrument rules and targeting rules (Svensson, 2005; Walsh, 2003; Woodford, 2003; Leitemo and Soderstrom, 2008). An example of an instrument rule (with the federal funds rate as instrument and nominal GDP as target) proposed by both Taylor (1993) and McCallum (1988, 1993) is one that requires the monetary authority to raise the federal funds rate whenever the growth rate of nominal GDP is unexpectedly high regardless of other information available to the monetary authority. On the other hand, the targets of monetary policy are a way to formalise the overall objectives of a monetary authority with all available information, then Svensson (1998, 2005) calls it a targeting rule. Cover *et al.* (2002) employ over two types of policy instruments, four target variables, and two types of rules to explore which combination of policy instrument and target variable would result in the best rule for monetary policy in Taiwan.

[10] The asymmetries in MS-AR process can be rewritten as two components, Gaussian and non-Gaussian. The non-Gaussian component is potentially asymmetric and presented as the contribution of the Markov chain (Clements and Krolzig, 2003).

[11] The test of MS-AR model against a linear null is complicated because the presence of unidentified nuisance parameters under the null of linearity and the scores associated with parameters under the alternative may be identically 0 under the null (See Hansen, 1992, 1996).

[12] See more details concerning model selection in Chapter 6.

[13] Krolzig (1997) points out that Markov switching models with more than four regimes do not provide a meaningful representation of the business cycle which in its simplest form consists of an expansion (boom) and a contraction (recession).

[14] Although the Schwarz Criterion (SC) does indicate the optimal order of autoregression, we still compare the regime switching behaviour for each variable for different orders of autoregression with the business cycle dates provided by the CEPD.

[15] Based on the log-likelihood function and the relationship between regime switching behaviour and the macroeconomic fundamentals, we find that the MSI(3)-AR(1) specification has the ability to characterise cyclical behaviour in both job creation and destruction rates in the manufacturing and service sectors. Similar results are found for the job destruction rate in the construction sector.

[16] Based on the MSIH(3)-AR(1) specification, job destruction in the construction sector does not have a clear and persistent regime classification between 1989 and 1998. The possible explanation is that job destruction was moving across the intercepts of regime 1 (1.21) and regime 2 (1.37) over the 1989-1998 period so that it was difficult for the MSIH(3)-AR(1) model to identify as a long persistent regime 1 or regime 2 (see Table 7.3).

[17] All the computations reported in this Chapter were undertaken using OX 3.4, see H-M Krolzig workpage http://www.kent.ac.uk/economics/staff/hmk/.

[18] The likelihood ratio test statistic: $LR=-2(\lambda-\lambda_0)$ with an asymptotic Chi-square distribution, where λ and λ_0 denotes the log-likelihood value of three (or two)-regime MS(M)-AR(p) and single-regime AR(p) model. Please see more details in Chapter 6.

[19] The industry sector is defined as economic activity that involves the processing of raw

materials and their use in the manufacture of goods (Statistical Year Book of Taiwan, 2007).

[20] The parametric asymmetry (MS) tests are designed to detect asymmetries in the Markov chain component (first-moment asymmetry), whereas the NP tests would be expected to reject the null of asymmetry in the presence of “heteroscedasticity”. Clements and Krolzig (2003) show that the NP test is less powerful than the parametric test when there are heteroscedastic disturbances.

[21] One possible limitation of the matching model is that it is unable to reproduce the volatility of the job find rate, unemployment, and vacancies observed in the US Current Population Survey (CPS) data (Shimer, 2004; Hall, 2005).

[22] In Andolfatto *et al.* (2004), information friction is captured by the enterprise’s expectation function of future money growth. Furthermore, search friction is encapsulated in a matching function, which describes the probability that a searching worker finds a match.

[23] For example, empirical evidence shows that job creation and destruction occur~~s~~ simultaneously at the plant-level (See Chapter 5).

[24] Davis and Haltiwanger (2001) explore the effects of oil price shocks on job creation and destruction in the US manufacturing sector from 1972 to 1988. They find that employment growth declined sharply following a negative shock but exhibited little change following a positive shock. The asymmetric employment response to positive and negative shocks has also been found in Hamilton (1996).

[25] In the present chapter, we do not examine matching theory (Garibaldi, 1997) or search theory (Andolfatto *et al.*, 2004). By contrast, we pay more attention to the impact of monetary policy on job creation and destruction.

[26] The Great Taiwan Bubble started with economic liberalisation in the late 1980s. The

stock index surged from 2611 at the end of January 1988 to 10678 at the end of January 1990. However, the bull market collapsed with the start of the first Gulf War. The stock index dropped from a peak of 11983 at the end of February to 2912 at the end of October, 1990 (Champion, 1998).

[27] Mitchell (2001, 2002) shows that the impact of disinflation policies is underestimated given that unemployment rates in fifteen OECD countries exhibit high degrees of persistence following negative output shocks.

[28] For example, the early 1980s recession in US was mainly due to the contractionary monetary policy established by Paul Volcker that aimed to control the high inflation (Krugman, 1991). As a consequence, the ‘costs’ of contractionary monetary policy are greater than the benefits of expansionary monetary policy if recessions are steeper than expansions.

Chapter 8 Regional Business Cycles

8.1 Introduction

Business cycle analysis has been one of the most interesting and enduring research areas for economists since the beginning of the nineteenth century.[1] Studies of regional business cycles developed in the 1920s and were pioneered by McLaughlin (1930), Vining (1945, 1946a, 1946b, 1949) and Isard (1949, 1957, 1960). In the last decade, there have been many studies of the dynamics of the business cycle in different regions of different countries (Sill, 1997; Clark and van Wincoop, 1999; Crone, 1999; Rissman, 1999; Selover *et al.*, 2005).[2]

The study of regional business cycles has important implications for regional policy making and the dating of the overall business cycle. If the business cycle of a particular region is large and unrelated to the business cycles in other regions, a more regionally-specific policy focus may be appropriate. If, however, there is a common regional business cycle, a more aggregate centralised policy (for example, fiscal or monetary policy) is warranted.

Most studies of regional business cycles have found that business cycles across different regions and states are highly correlated, which suggest the existence of a common regional business cycle.[3] Clark (1992), for example, finds that regional employment growth rates in the USA tend to move together over time. Carlino and Keith (1998, 2000) apply co-integration[4] analysis to investigate real per capita personal income in the four core regions of the US. They find a co-integrating relationship between these four core regions and co-movement was also found in the cyclical behaviour of real per capita personal income. Clark and Eric (1999) explore the influence of national borders on business cycle synchronisation in the US as well as the European Union countries. They find that regional business cycles are more synchronised with each other in the US than those in European countries.

The dating of a common regional business cycle would help in the understanding of fluctuations of the aggregate economy because most business cycle studies have been based on aggregate data.[5] Dating the turning points of business cycle has been considered to be the principal task of empirical business cycle research. Although Taiwan's business cycle has been explored in a number of studies (for example, Huang *et al.*, 1998; Chen and Lin, 2000; Chen, 2002; Chang, 2004), the properties of regional business cycles in Taiwan have not been investigated. Moreover, the identification of Taiwan's turning points after 1990 is still a puzzle. The reason for this misidentification is that Taiwan experienced an averaged 8.5 percent GDP growth rate during expansionary periods, and 5.5 percent during recessionary periods prior to 1989. After 1990, the GDP growth rate declined to 5.5 and 2.5 percent in the expansionary and recessionary periods, respectively. As a result, previous studies mistakenly identify the post-1990 period as a recession. Recently, Chen and Shen (2006) employed a Markov-switching factor model with four variables (the real GDP growth rate, consumption expenditures and manufacturing sales) to explain this puzzle. The authors find that their model produces well-defined Taiwan's turning points in the post-1990 period.

The aim of this Chapter is to explore the characteristics of regional business cycles in Taiwan and shed further light on the "turning point identification" puzzle that has to date not been fully resolved.

Researchers use a variety of variables to explore co-movement across regions, including the growth of gross state product, the growth of industrial production, the growth of employment and unemployment rates. Rissman (1999) defines the business cycle as the co-movement of employment growth across different regions. Using a Kalman filter approach, he finds that employment growth across US regions tends to move simultaneously. Moreover, Rissman (1999) finds that the business cycle measured by employment growth precedes the National Bureau of Economic Research (hereafter NBER)-dated peaks, and recoveries tend to precede the NBER-dated recoveries.

In contrast to Rissman (1999), this Chapter investigates the possibility of co-movement of employment growth across regions using a Markov switching autoregresions (MS-AR) model. In the literature, several methodologies are employed to study the common regional business cycle, including correlation coefficients, vector autoregressions (VARs), Kalman filters, co-integration analysis, and the Markov switching autoregresions (MS-AR) model. In comparison with other methodologies, the MS-AR model has the great advantage of exploring the regime-switching behaviour of regional business cycles and dating the turning points of a common regional business cycle. Artis *et al.* (2004) use the Markov switching vector autoregressions (MS-VAR) to examine the existence of a common European business cycle.[6] They also use Pearson's contingency coefficient[7] and find that there is a high degree of concordance with respect to regime classification across European countries.[8] This suggests the existence of a common European business cycle. Based on the MS-VAR model they also find a common unobserved component governing the European business cycle for both industrial production indices and gross domestic product (GDP).

This Chapter extends the study of Rissman (1999) by analysing the regime switching behaviour of job creation and destruction across regions over the business cycle. In particular, the present chapter pays more attention to employment adjustment across regions during the business cycle transitions. Krolzig *et al.* (2002) employs the non-linear impulse response analysis[9] to examine regime change in the UK labour market. They find that moving from a recession to a regime of normal or high growth (expansion shock) leads to all variables (output, employment, and real earnings) responding positively. The way in which different regions react to an expansionary shock is still largely unknown in Taiwan. Hence, the non-linear impulse response analysis is adopted to investigate the response of each individual region to 'expansionary' and 'contractionary' shocks.[10]

In sum, this Chapter has three specific aims. First, the similarities and differences of regional business cycles are investigated using employment growth rates (net employment change) as well as job creation and destruction rates, for which graphical analysis, simple correlation coefficients, the univariate Markov switching autoregression model, Pearson’s contingency coefficient and Fisher’s exact test are employed. Second, a multivariate Markov switching autoregression model is then employed to identify a common regional business cycle in Taiwan. In this section, we attempt to shed light on the identification puzzle by dating the turning points of the regional business cycle. At regular intervals the Council of Economic Planning and Development (CEPD) in Taiwan compiles the official monitoring indicator[11] to identify the Taiwanese business cycle. The CEPD-defined chronologies are taken as the benchmark for comparison purposes. Third, non-linear impulse response analysis will examine the response of each individual region to business cycle transitions.

The Chapter is organised as follows. Section 2 investigates the form of the regional cycles in Taiwan. Section 3 deals with the issue of identification and dating of a common regional business cycle. Section 4 applies the non-linear impulse response analysis to investigate how job flows in different regions respond to a change in regime. Section 5 synthesises the key elements of this chapter.

8.2 Individual regional business cycle

The main purpose of this Section is to investigate the similarities and differences of the individual regional business cycles. While the aggregate business cycle is simply the aggregated (weighted) effect of the regional cycles, regional fluctuations could be crucial from a regional policy perspective. The behaviour of the individual regional business cycles is explored from two perspectives. First, basic graphical analysis and correlation coefficients are used to examine the relationship between the four core regions. Second, univariate MS-AR models, Pearson's contingency coefficient and Fisher's exact test are employed to investigate whether the regime switching behaviour is similar across these regions.

Figure 8.1 plots the time series behaviour of employment growth for the four core regions.[12] Note that three regions (North Region, Central Region, and South Region) are significantly influenced by the recession (December 2000 – March 2002). Figures 8.2 and 8.3 show the cyclical behaviour of job creation and destruction rates by region. The recession has more impact on job creation rates than on job destruction rates. In the North Region, for example, the job creation rate fell from 1.2 to 0.4 per cent during the recession period, while the destruction rate increased from 1.1 to 1.4 per cent. This indicates that plants reacted to the recession shock by mainly adjusting employee entry rather than exit. In other words, employers responded to the recession by reducing hiring and letting job destruction, which is in part voluntary, bring employment down to the desired level. The alternative was continuing to hire at the same rate, but raising the rate of job destruction even more. Similar results have been found in French establishments by Abowd *et al.* (1999) and in the Finish business sector by Ilmakunnas and Maliranta (2003).

Figures 8.1, 8.2 and 8.3 suggest that the East Region was free from the impact of the recession. This could be because the East Region is geographically isolated from the other three regions and has evolved into a distinctive regional economy with it own unique trajectory.[13] While there are slight variations in behaviour[14], it is plausible that labour market performance in the North, Central, and South Regions is highly correlated. This conclusion is also consistent with the correlation coefficients in Table 8.1. The correlation coefficients of net employment rates between the North, Central and South Regions are significant at the 5 per cent level. Furthermore, the significant correlation coefficients are found between the North, Central, South and East Regions with respect to job creation rates and job destruction rates.

Figure 8.1 The cyclical behaviour of regional employment growth rates, seasonal adjusted.

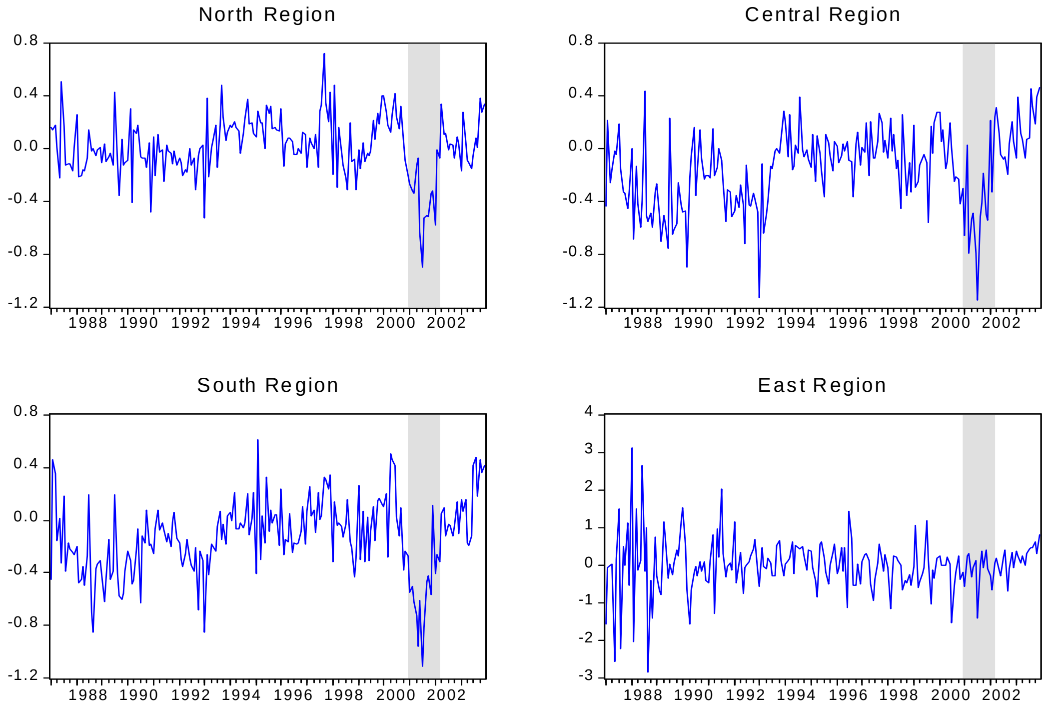


Figure 8.2 The cyclical behaviour of regional job creation rates, seasonal adjusted.

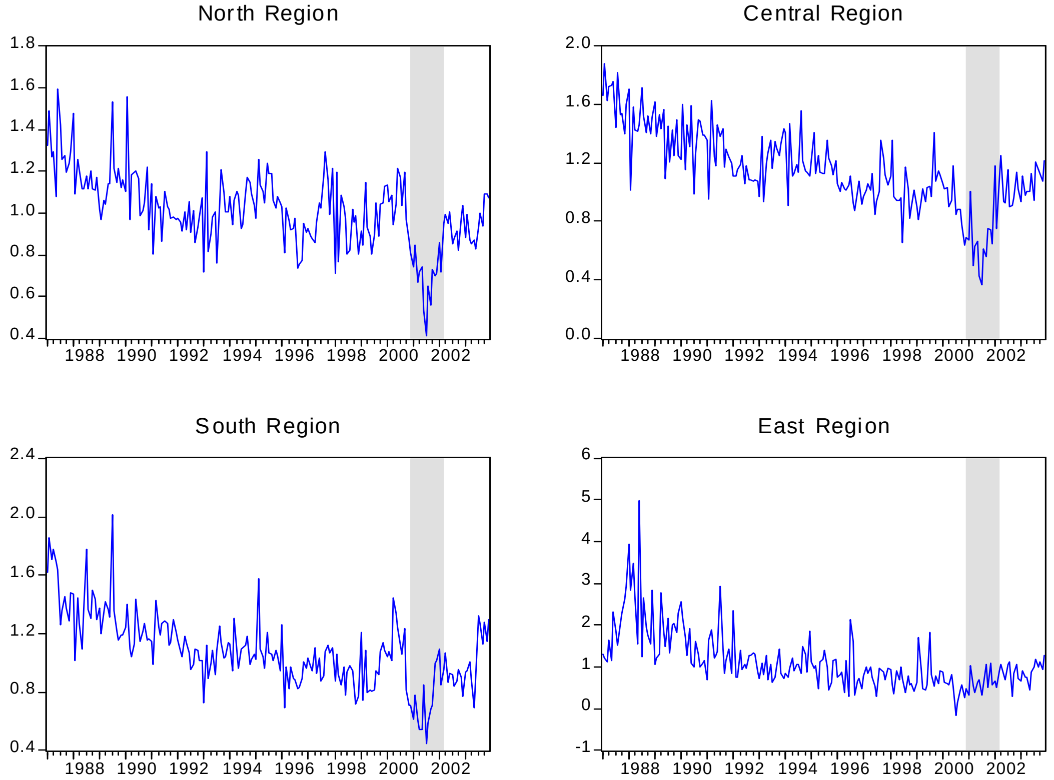


Figure 8.3 The cyclical behaviour of regional job destruction rates, seasonal adjusted.

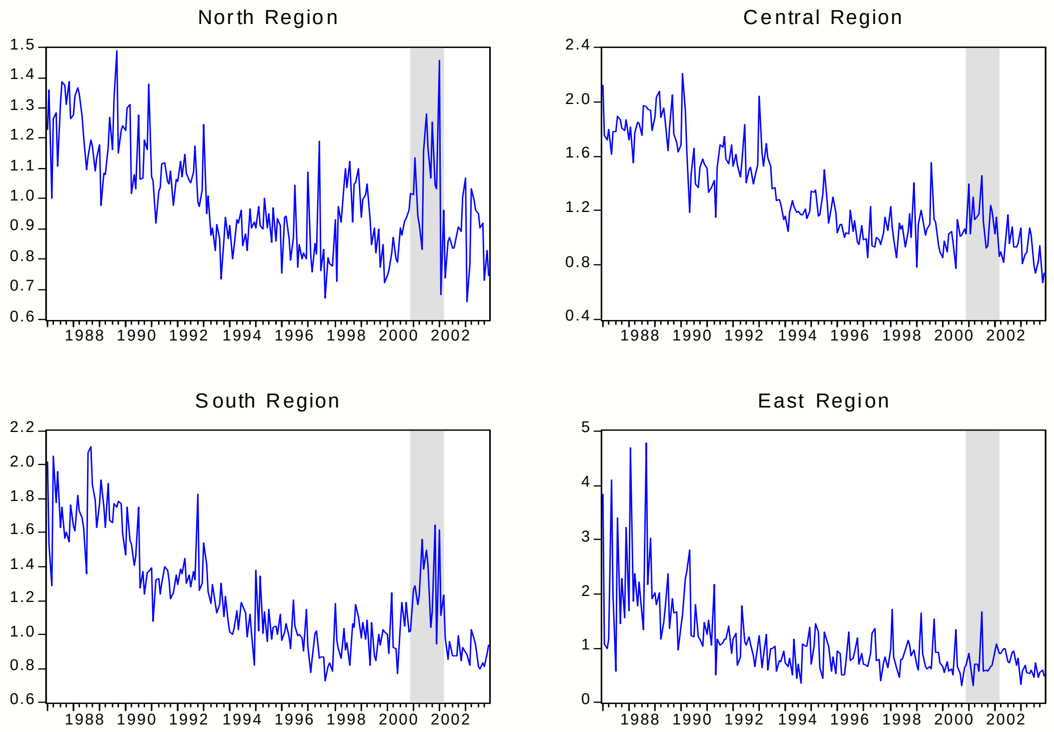


Table 8.1 Correlation Matrices by region 1987-2003

Employment growth rate	North Region	Central Region	South Region
Central Region	0.547*		
South Region	0.573*	0.679*	
East Region	0.133	0.165	0.147
Job creation rate	**North Region**	**Central Region**	**South Region**
Central Region	0.727*		
South Region	0.699*	0.777*	
East Region	0.473*	0.536*	0.468*
Job destruction rate	**North Region**	**Central Region**	**South Region**
Central Region	0.686*		
South Region	0.731*	0.846*	
East Region	0.532*	0.621*	0.640*

Notes: * indicate statistical significance at 5%.

Since Hamilton (1989) introduced the new approach to US business cycle analysis, the Markov switching autoregression model has been extensively applied in macroeconomics. Followed the specification strategy proposed by Krolzig (1997), we employ the Akaike information criterion (AIC) and the Schwarz criterion (SC) to decide the appropriate order of ARMA(p*,q*).

The results of the model selection criteria for job flow rates across the four regions are listed in Appendix A. Similar to the results in Chapter 7, the AIC suggests a higher order ARMA process compared to the SC with the exception of the job destruction rate in the South Region and the employment growth rate in the East Region. For example, the AIC suggestion for the job creation rate in the North Region - ARMA(6,4) corresponds to MSI(5)-AR(2) based on the ARMA representation theorems. In other words, the job creation rate in the North Region is best characterised as a hidden order Markov model with five regimes in the intercept term. Similar results also apply to the job destruction rate in the North Region. However, the Markov switching model with five regimes in the intercept does not provide a meaningful characterisation of the regime switching behaviour of job creation and destruction rates in the North Region. As a result, the AIC provides no guidance on the selection of regime (M) or autoregressive orders (p) for the job creation and destruction rates in the North Region.

On the other hand, the Markov switching model based on the SC does provide a reasonable characterisation of the regime switching behaviour of job flows with the exception of the employment growth rate in the East Region. The recommendations for the MSI(M)-AR(p) and MSM(M)-AR(p) specifications for the job creation, job destruction and employment growth rates are summarised in Table 8.2.

Table 8.2 Parsimonious MSI(M)-AR(p) and MSM(M)-AR(p) specifications

Variable		ARMA(p,q)	MSI(M)-AR(p)	MSM(M)-AR(p)
	Employment growth	2,2	MSI(3)-AR(0)	MSM(3)-AR(0)
North Region	Job creation	3,2	MSI(3)-AR(1)	MSM(2)-AR(2) MSM(3)-AR(1)
	Job destruction	2,2	MSI(3)-AR(0)	MSM(3)-AR(0)
	Employment growth	4,1	MSI(2)-AR(3)	
Central Region	Job creation	2,2	MSI(3)-AR(0)	MSM(3)-AR(0)
	Job destruction	4,2	MSI(3)-AR(2)	
	Employment growth	4,1	MSI(2)-AR(3)	
South Region	Job creation	8,2	MSI(3)-AR(6)	
	Job destruction	2,2	MSI(3)-AR(0)	MSM(3)-AR(0)
	Employment growth	8,2	MSI(3)-AR(6)	
East Region	Job creation	6,3	MSI(4)-AR(3)	
	Job destruction	6,8	NA	

A further consideration is that the MSM model assumes the regime switching behaviour to be immediate and abrupt whereas, by contrast, the MSI model adopts the more plausible assumption that the mean shifts follow a smooth path (Krolzig, 1997). In practice, the various job flow rates rarely exhibit abrupt changes. As a result, a MSI-AR model is chosen as the preferred specification across the four regions.

In the next step, we focus on whether Markov switching models for each variable for different orders of autoregression has superior statistical properties based on its log-likelihood function as well as its relative ability to characterise the region's cyclical behaviour. For example, MSI(3)-AR(0) is selected by the SC criterion as a feasible Markov-switching (MS) model for the employment growth rate in the North Region. As is depicted in Figure 8.4, the MSI(3)-AR(0) and MSI(3)-AR(1) models are superior to models with higher AR orders, such as MSI(3)-AR(2) and MSI(3)-AR(3)[15], in tracking the turning points, especially the periods of economic contraction in the late 1990s and deep recession in the early 2000s. Furthermore, the MSI(3)-AR(0) model outperforms the MSI(3)-AR(1)[16] and the MSIH(3)-AR(1) models[17] based on the likelihood ratio test. As a result, the MSI(3)-AR(0) is our preferred specification for the employment growth rate in the North Region.

Figure 8.4 MSI(3)-AR(p) specifications for the employment growth rate in the North Region

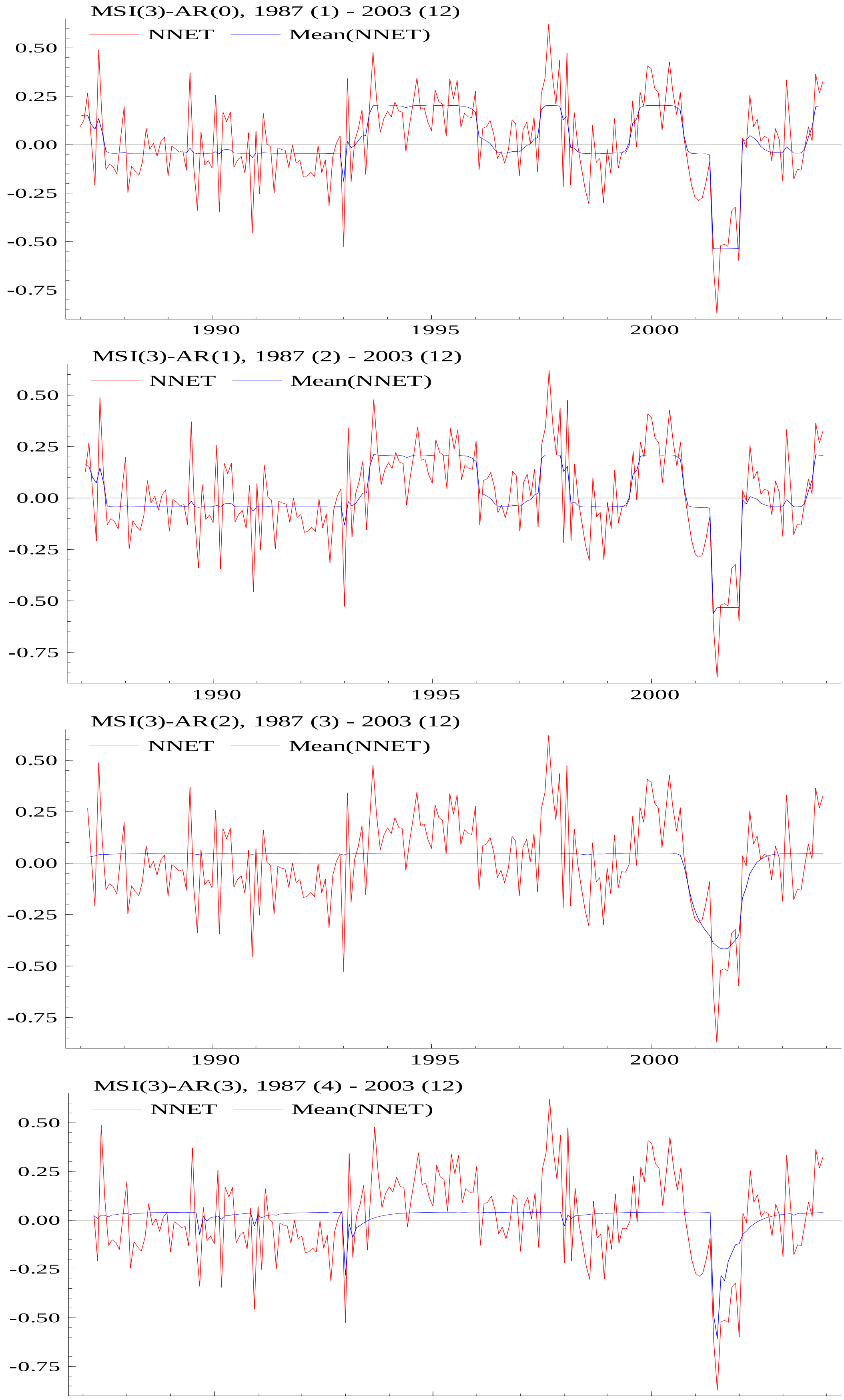


Table 8.3a Univariate MS-AR models of the individual regional business cycle

	Employment growth			
	North Region	Central Region	South Region	East Region
Intercept (regime1)	-0.534* (-9.45)	-0.451* (-15.26)	-0.395* (12.53)	-0.066 (-1.34)
Intercept (regime2)	-0.045* (-2.82)	-0.009* (-2.45)	-0.004* (-2.19)	0.114 (0.42)
Intercept (regime3)	0.216* (8.43)			
AR(1)		0.037** (1.51)	0.035* (2.54)	-0.126 (-1.53)
AR(2)				
AR(3)				
p11	0.84	0.93	0.94	0.68
p12	0.15	0.07	0.06	0.32
p13	0.01			
p21	0.01	0.03	0.03	0.30
p22	0.95	0.97	0.97	0.70
p23	0.05			
p31	4.2E-08			
p32	0.09			
p33	0.91			
Probability of regime1	0.04	0.32	0.31	0.48
Probability of regime2	0.64	0.68	0.69	0.52
Probability of regime3	0.32			
Duration of regime 1 (months)	6.23	13.52	17.13	3.08
Duration of regime 2 (months)	18.19	28.89	37,39	3.36
Duration of regime 3 (months)	10.72			
Obs in regime 1	8.3	68.1	67.4	97.1
Obs in regime 2	132.9	135.9	136.6	105.9
Obs in regime 3	62.7			
Log likelihood	62	2,76	-0.15	-211
Linearity test	88*	43*	31*	-0.01

Note: * and ** represent statistical significance at 1% and 5%, respectively. t-statistics are in parentheses.

Table 8.3b Univariate MS-AR models of the individual regional business cycle (cont.)

	Job creation				Job destruction			
	North Region	Central Region	South Region	East Region	North Region	Central Region	South Region	East Region
Intercept (regime1)	0.546* (8.84)	0.505* (7.52)	0.553* (9.01)	0.72* (-11.92)	0.873* (87.99)	0.322* (4.08)	0.875* (13.18)	0.903* (-12.81)
Intercept (regime2)	0.782* (11.02)	0.762* (9.22)	0.677* (8.49)	1.252* (-10.05)	1.074* (68.91)	0.326* (3.87)	1.167* (13.05)	2.135* (-13.27)
Intercept (regime3)	0.947* (10.81)	0.996* (8.91)	0.876* (7.83)	2.667* (-14.06)	1.287* (61.55)	0.512* (4.30)	1.520* (13.26)	
AR(1)	0.213* (3.02)	0.286* (3.72)	0.385* (5.70)	0.144** (-2.42)		0.428* (6.08)	0.115* (1.75)	0.025* (-0.39)
AR(2)						0.120* (1.58)		
AR(3)						0.147** (2.14)		
p11	0.92	0.94	0.96	1	0.98	0.85	0.99	0.99
p12	0.08	0.06	0.04	7.41E-17	0.02	0.15	0.01	0.01
p13	2.1E-11	1.3E-09	0.0002	8.21E-20	1.5E-05	0.271	9.1E-06	
p21	0.01	0.01	0.05	1.49E-07	0.04	0.22	0.04	
p22	0.99	0.98	0.78	0.82	0.9	0.78	0.94	0.03
p23	1.2E-08	0.01	0.17	0.18	0.07	5.1E-09	0.02	0.97
p31	3.6E-11	2E-11	4.2E-09	7.00E-02	0.04	0.002	1.2E-06	
p32	0.02	0.03	0.27	0.55	0.13	0.01	0.04	
p33	0.98	0.97	0.73	0.39	0.83	0.98	0.96	
Probability of regime1	0.09	0.12	0.44	0.63 0.23	0.59	0.58	0.69	0.84
Probability of regime2	0.91	0.63	0.35	0.14	0.29	0.42	0.19	0.16
Probability of regime3	0	0.25	0.22	204.25	0.11	0	0.11	
Duration of regime 1 (months)	12.73	16.29	22.73	13.15	40.37	6.5	93.99	164.56
Duration of regime 2 (months)	125.36	44.85	4.46	8.21	9.78	4.63	16.14	31.16
Duration of regime 3 (months)	42.73	36.27	3.75	85.5	5.87	74.3	24.34	
Obs in regime 1	14.8	19.7	87	71.2	105.8	73.6	108.1	164
Obs in regime 2	146.5	107.2	70.6	46.3	67.6	54.1	55.6	39
Obs in regime 3	41.8	76.1	45.4	-112	30.6	73.3	39.3	
Log likelihood	121	70	85	127*	162	91	89	-153
Linearity test	35*	52*	40*	127*	191*	8.57**	77*	74*

Note: * and ** represent statistical significance at 1% and 5%, respectively. t-statistics are in parentheses.

Table 8.3 reports the estimation results for employment growth, and job creation and job destruction rates based on the MSI(M)-AR(p) models.[18] The estimates seem reasonable as most of the intercept terms for the three regimes are statistically significant at the 1 per cent level with the exception of the employment growth specification for the East Region. According to the value of the maximized likelihood function, the linearity tests consistently rejected the null of linearity. Transition dynamics of the regimes can be observed by analyzing the transition probabilities. Note from the transition probabilities for job creation rate given in Table 8.3b, regime 3 in the South Region, for example, can be reached via regime 2 and rarely from regime 1 (p_{13}=0.0002). Also Table 8.3 shows that the regimes are highly persistent. In the North Region, for example, regime 2 for job creation lasts an average of 125 months (p_{22}=0.99) and regime 3 lasts an average of 43 months (p_{33}=0.98).

Figure 8.5 plots the regime switching of employment growth across the four regions. Regime 1 corresponds to low growth (recession), Regime 2 denotes normal growth, while Regime 3 represents high growth episodes. In terms of employment growth rates, the durations of the different regimes suggest that the three regions experienced different dynamics over the sample period. The duration of the low growth phase in the North Region was very brief, with an average of 7 months. Periods of low growth in the Central and South Regions displayed more inertia with an average of around 14 and 17 months, respectively. On the other hand, the high growth phase was estimated to last around 11 months in the North Region and was not found in the Central and South Regions.[19] This feature confirms that the main source of employment growth for the period 1987-2003 was the North Region. It is worthwhile stressing that the univariate MS-AR models seem to provide relatively good representations of the recession period (December 2000 to March 2002) in the North, Central, and South Regions. Moreover, the regime switching characteristics are similar across the Central and South Regions.

Univariate MS-AR models are also employed for the job creation and job destruction rates in the four regions. The results are presented in Figures 8.6 and 8.7. In the job creation rate panel, regime 1 denotes recession, regime 2 corresponds to normal growth, while regime 3 characterises high growth. In the job destruction rate panel, regime 1 corresponds to low rates of destruction, regime 2 represents moderate rates of destruction, and regime 3 characterises high rates of destruction. As can be seen in Figure 8.6, the recession is identified in the North and Central Regions, but the MS-AR model misses the recession in the South Region. Note that the regime switching behaviour of the job creation rate is largely consistent in the North and Central Regions. On the other hand, in the case of job destruction, the recession period is captured in the North and South Regions but not in the Central Region.

Figure 8.5 Employment growth rates by region: Univariate models

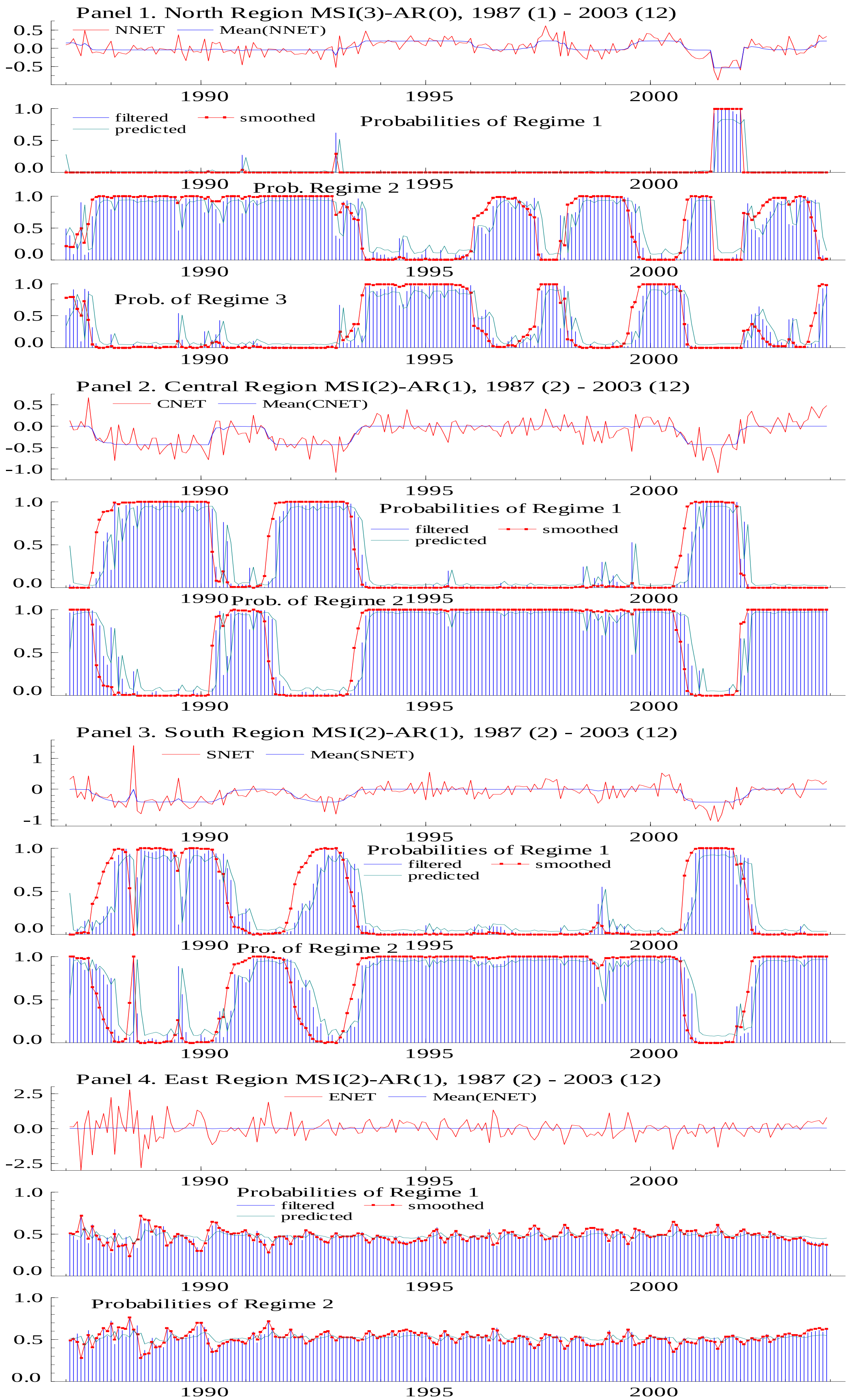


Figure 8.6 Job creation rates by region: Univariate models

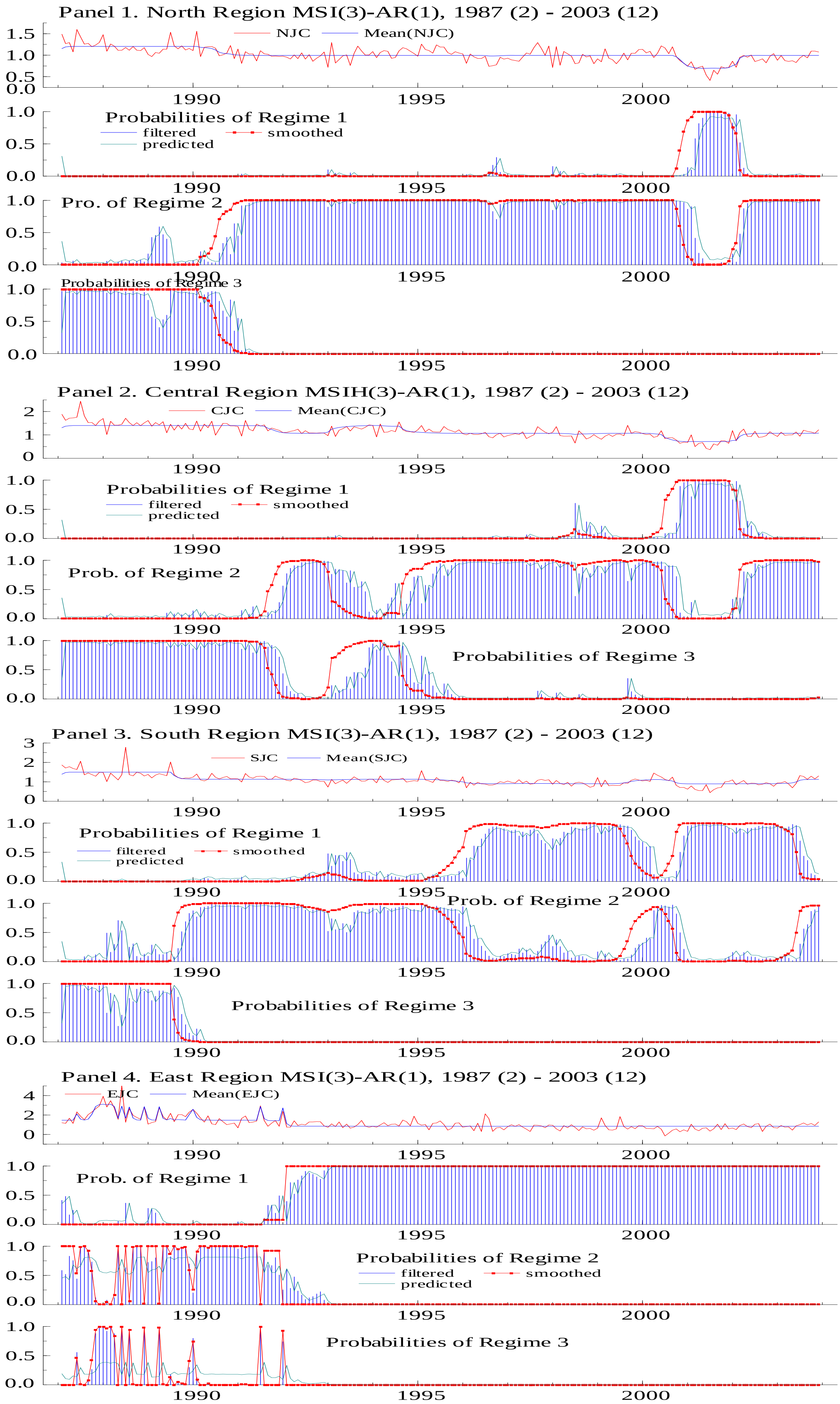
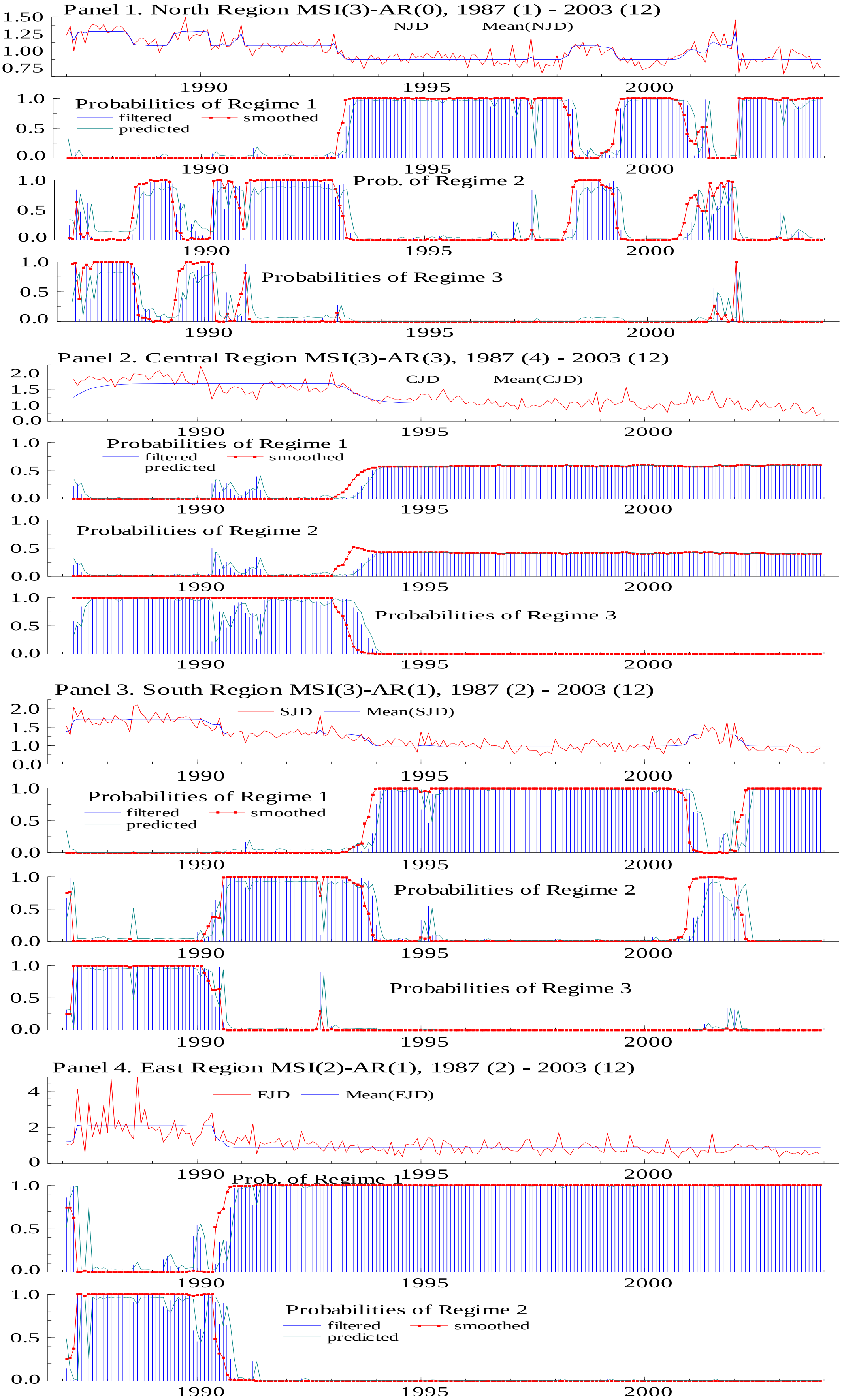


Figure 8.7 Job destruction rates by region: Univariate models



In order to further explore the regime switching behaviour of regional business cycles across three regions, Pearson's contingency coefficient and Fisher's exact test are employed to examine the existence of the common regional business cycle.[20] A binary time series[21] is obtained from the regime classification and a contingency table is then constructed with respect to the frequencies of expansion and contraction. The corrected contingency coefficients and Fisher's exact test statistics across the three regions are reported in Tables 8.4 and 8.5, respectively. As can seen in Table 8.4 there is a high degree of commonality in the employment growth rates for North, Central and South Regions if we use 60 as the threshold level. There also is a high degree of concordant regime switching of job creation and destruction rates across the North, Central and South Regions with the exception of the job creation rate in the South Region. Moreover, in Table 8.5 the results based on the Fisher's exact test establish a significant association between the regime switching regimes across the North, Central and South Regions, irrespective of the variable considered.

Table 8.4 Corrected contingency coefficient by region 1987-2003

Variable : Employment growth rate	North Region	Central Region
Central Region	62.40	
South Region	64.09	91.18
Variable : Job creation rate	**North Region**	**Central Region**
Central Region	78.31	
South Region	54.66	52.22
Variable : Job destruction rate	**North Region**	**Central Region**
Central Region	71.55	
South Region	79.22	61.53

Table 8.5 Fisher's exact test by region 1987-2003

Variable : Employment growth rate	North Region	Central Region
Central Region	0.027*	
South Region	0.016*	0.001**
Variable : Job creation rate	**North Region**	**Central Region**
Central Region	0.005**	
South Region	0.035*	0.047*
Variable : Job destruction rate	**North Region**	**Central Region**
Central Region	0.014*	
South Region	0.005**	0.037*

Notes: ** and * indicate statistical significance at 1% and 5%, respectively.

In summary, significant correlation coefficients with respect to net employment rates, job creation rates and job destruction rates are found between the North, Central and South Regions. Apart from the East Region, most regions record correlations higher than 0.6. Moreover, using Pearson's contingency coefficient and Fisher's exact test, the empirical results also suggest a high degree of commonality among the North, Central, and South Regions. The high degree of similarity motivates us to move to the Markov switching vector autoregression (MS-VAR) model to investigate the common regional business cycle among the North, Central, and South Regions.

8.3 The common regional business cycle

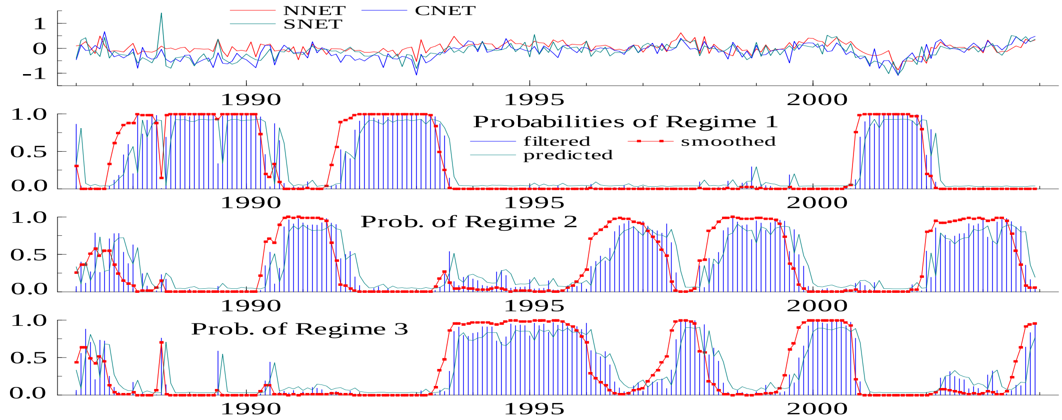
One special advantage of the Markov switching vector autoregression model (MS-VAR) is that it is able to investigate whether the set of variables share a common unobserved component that drives the cyclical changes (Artis *et al.,* 2004). Since the East Region has not shown similar cyclical behaviour, we initial explore a common regional business cycle[22] based on the North, Central, and South Regions.[23] Furthermore, to aid comparison we then add the East Region and re-explore the properties of a common regional business cycle.

We follow the specific-to-general approach[24] outlined in Krolzig (1997). A three-regime Markov-switching vector autoregression with one lag is found to be the preferred specification for the employment growth rate. The MS-VAR model is also superior to the linear representations and the linearity tests are rejected.

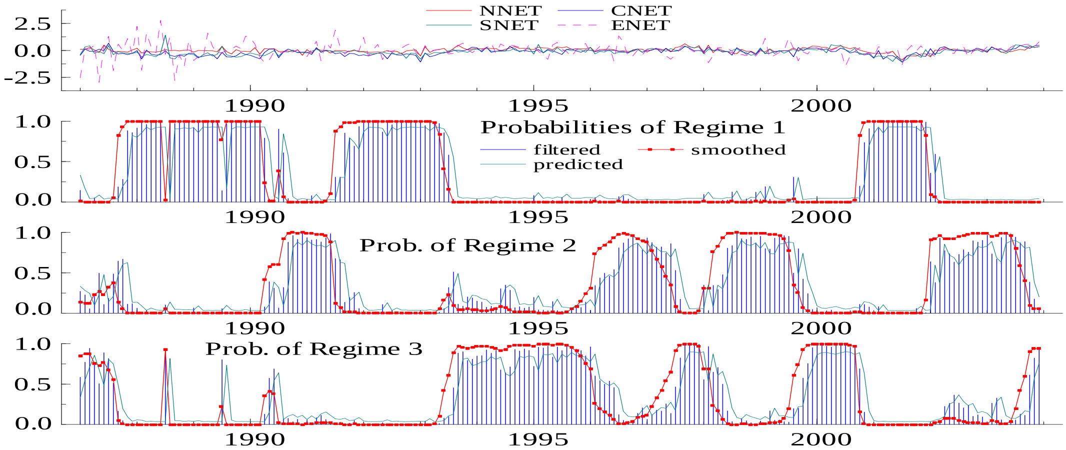
Figure 8.8 plots the regime switching behaviour of the common regional business cycle of employment growth across the three regions (North, Central, and South) in panel 1 and four regions (North, Central, South and East) in panel 2, respectively. In both panel 1 and panel 2, Regime 1 denotes low growth (recession), Regime 2 is associated with the moderate growth, while Regime 3 represents high growth. As is depicted in Figure 8.8, the regime switching characteristics of the common regional business cycle are largely similar in panel 1 (three regions) and panel 2 (four regions). The possible explanation is that the employment growth rate in the East Region is relatively small and, hence, the common regional business cycle will be dominated by the other three regions (North, Central, and South).

Figure 8.8 The common business cycle of net employment growth with business cycle indicators, 1987-2003.

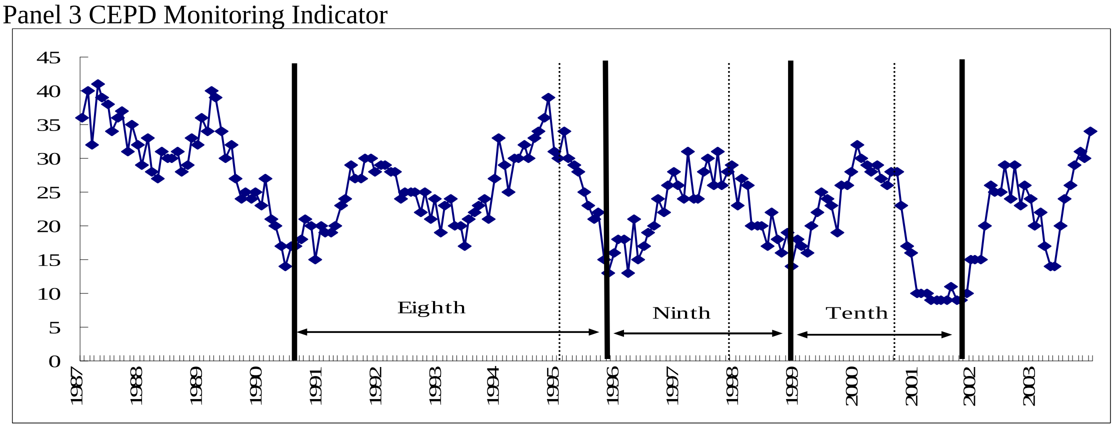
Panel 1 (Three regions) MSI(3)-VAR(1)



Panel 2 (Four regions) MSI(3)-VAR(1)



Panel 3 CEPD Monitoring Indicator



Notes: The vertical axis in panel 3 measures the CEPD monitoring indicator. A score between 9 and 16 indicates slowdown; 17 to 22 indicates a transitional period; 23 to 31 indicates growth; 32 to 37 indicates transitional period; and 38 to 45 indicates overheating (CEPD, 2008).

In Figure 8.8, we also report the business cycle indicators proposed by CEPD. Note that the common regional business cycle generated by the MS-VAR model roughly corresponds to the timing of the business cycle based on monitoring with expansions and contractions occurring at approximately the same times as indicated by the CEPD, irrespective of whether the East Region is included. The timing of regime switching of the employment growth rate as reported in Table 8.6 is also consistent with the official dating of trough and peak in Table 8.7. Moreover, the period of recession measured by the MS-VAR model tends to precede the CEPD-dated recession, which is consistent with the US case in Rissman (1999). This finding suggests that an employment growth index would help to monitor the expansion and contraction phases of business cycles in Taiwan.

Table 8.6 Regime classification of common regional business cycle

	Employment growth		Job creation		Job destruction	
	Regime	Period	Regime	Period	Regime	Period
Three Regions	Low growth (recession)	1987:09-1990:05 1991:08-1993:05 2000:09-2001:08	Low growth (recession)	2000:04-2001:12	Low reduction	1993:02-1998:03 1999:04:2000:10 2002:02-2003:12
	Moderate growth	1990:07-1991:07 1996:04-1997:06 1998:03-1999:06 2001:09-2003:12	Moderate growth	1991:11-2000:03 2002:01-2003:12	Moderate reduction (recession)	1998:04-1993:03 2000:11-2002:01
	High growth	1987:02-1987:08 1990:06-1990:06 1993:06-1996:03 1997:07-1998:02 1999:07-2000:08	High growth	1987:02-1991:10	High reduction	1987:02-1993:01
Four Regions	Low growth (recession)	1987:09-1990:03 1991:07-1993:05 2000:10-2001:12	Low growth (recession)	2000:04-2001:12	Low reduction	1993:04-2000:11 2002:02-2003:12
	Moderate growth	1990:04-1991:06 1996:02-1997:04 1998:03-1999:07 2001:01-2003:12	Moderate growth	1990:06-2000:03 2002:01-2003:12	Moderate reduction (recession)	1990:08-1993:03 2000:12-2002:01
	High growth	1987:02-1987:08 1990:06-1990:06 1993:06-1996:01 1997:05-1998:02 1999:08-2000:09	High growth	1987:02-1990:05	High reduction	1987:02-1990:07

Table 8.7 The CEPD-defined business cycle in Taiwan

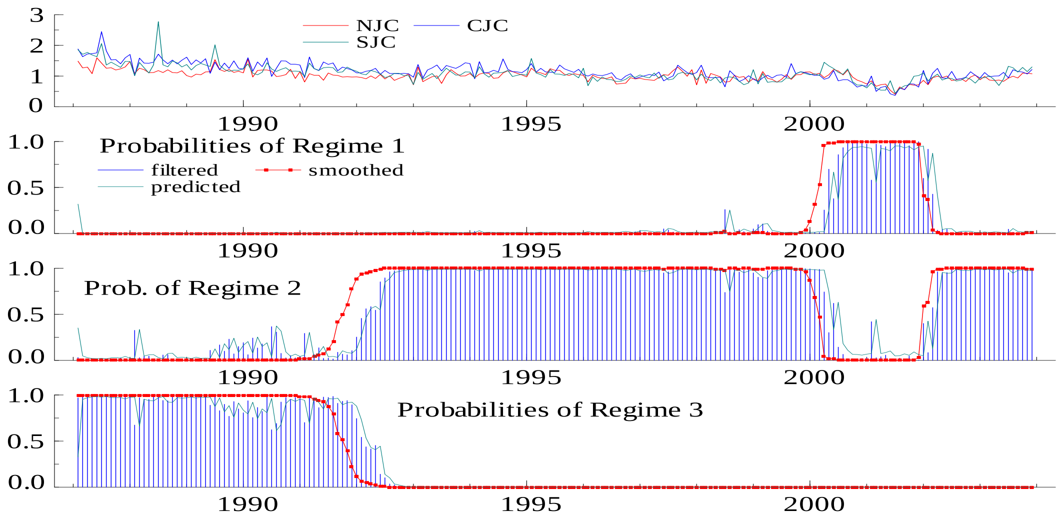
	Trough	Peak	Trough
Eighth	1990:08	1995:02	1996:03
Ninth	1996:03	1997:12	1998:12
Tenth	1998:12	2000:10	2001:09

The three-regime Markov-switching vector autoregression model with one lag is also the preferred specification for the job creation and destruction rates based on the specification strategy outlined by Krolzig (1997). The resulting smoothed and filtered probabilities of the three-region common regional business cycle are shown in Figure 8.9. In the job creation rate panel, Regime 1 denotes recession, Regime 2 correspond to normal growth, while Regime 3 characterises high growth. Moreover, in the job destruction rate panel, Regime 1 corresponds to low rates of job destruction, Regime 2 represents moderate rates of job destruction, and Regime 3 characterises high rates of job destruction, 1987-2003.

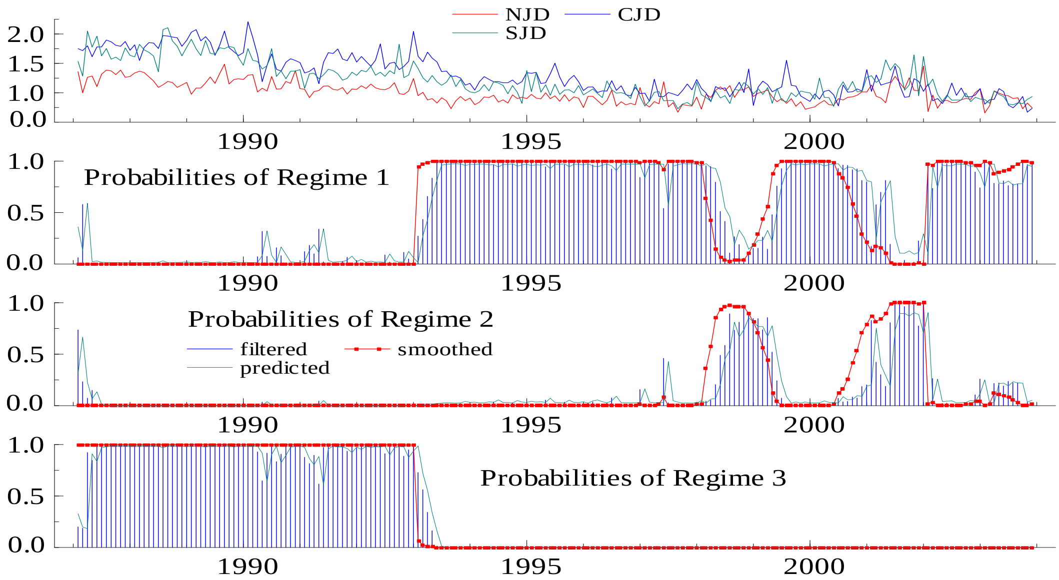
Comparing the top panel of employment growth and the middle and bottom panels of job creation and destruction rates, we find enormous fluctuations in job creation and destruction underlying the relatively smooth trend in net employment change. For example, employment growth was classified as low over the period September 1987 – May 1990 (see Table 8.6). Meanwhile, both the job creation and destruction rates are classified in the high growth regime.

Figure 8.9 The 3-region common business cycle of job creation and destruction.

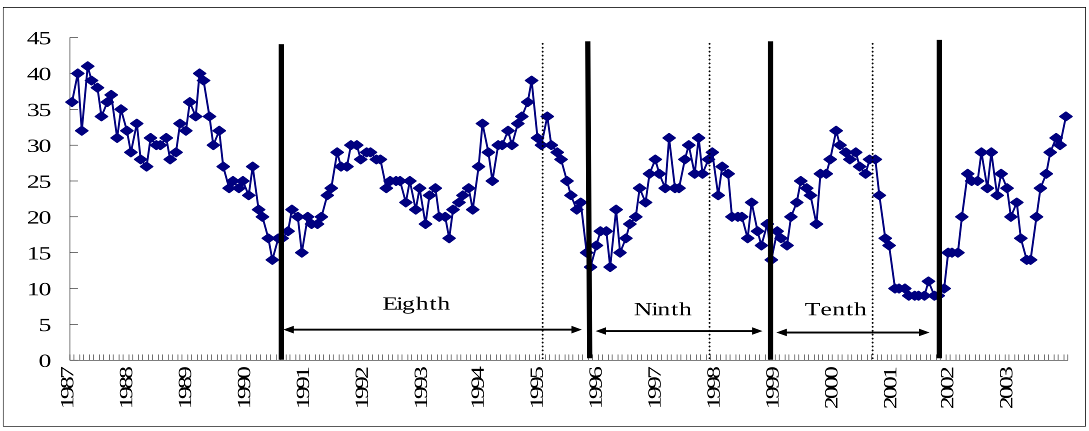
Panel 1 Job Creation MSI(3)-VAR(1)



Panel 2 Job Destruction MSI(3)-VAR(1)



Panel 3 CEPD Monitoring Indicator



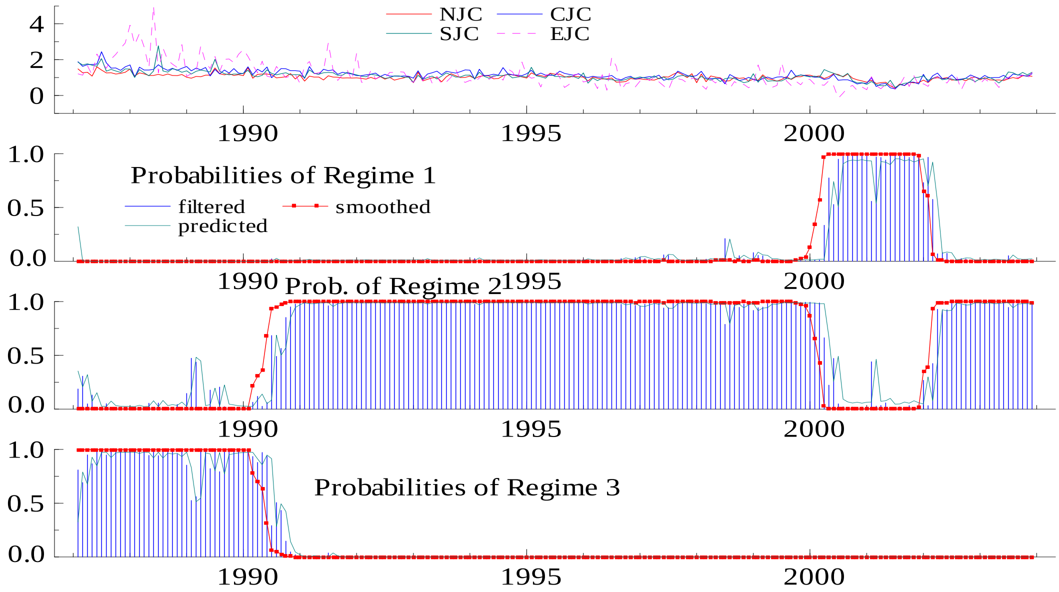
Notes: See Figure 8.8.

Figure 8.9 plots the regime switching behaviour of the co-movement of job creation and job destruction across the three regions (North, Central, and South) with CEPD-defined business cycle indicators. Note that the main source of the mild contraction in 1991 came from the change in job creation, which switched from the high growth regime to the moderate growth regime. The main source of recovery in 1993 was due to the decline in job destruction, which switched from the high reduction regime to the low reduction regime. Moreover, the regime switching behaviour of job creation seems to react to deep recession (December 2000-March 2002) earlier than that of job destruction (see also Table 8.6). One possible explanation is that employers tend to reduce job creation and postpone additional job destruction in the light of the need for employment adjustment due to the economic recession.

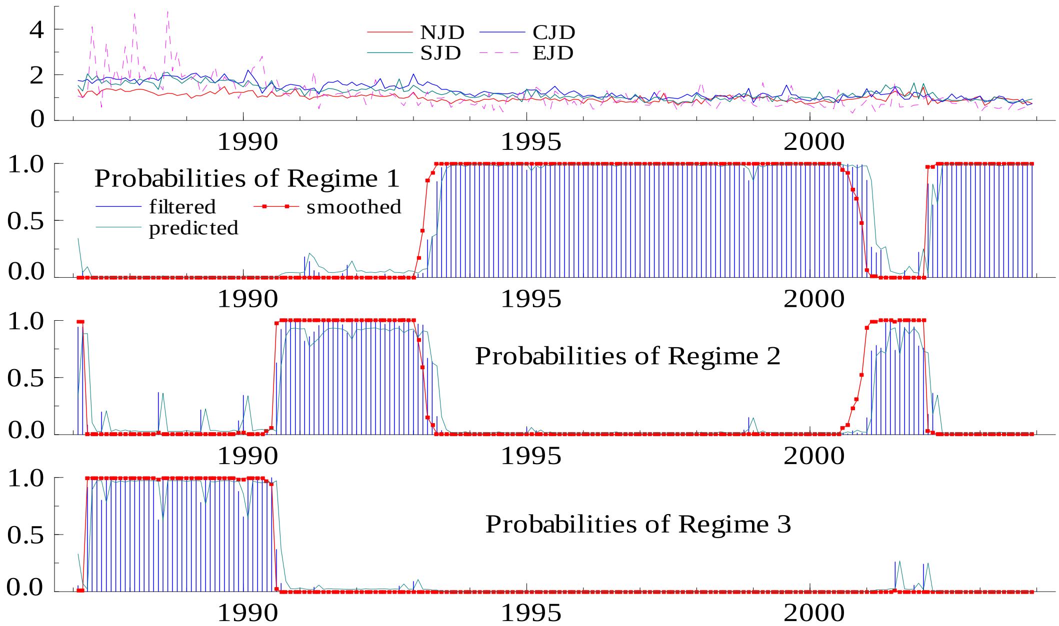
Figure 8.10 plots the regime switching behaviour of the co-movement of job creation and job destruction across four regions. In comparison to Figure 8.9, the regime switching characteristics of the common business cycle based on four regions shown in Figure 8.10 reveal slightly different behaviour. For example, the three-region common regional business cycle of job creation switched from a high growth regime to a moderate growth regime in 1991, whereas it was detected in 1990 in the four-region common business cycle (see Table 8.6). Also, the three-region common regional business cycle of job destruction switched from a high reduction regime to a low reduction regime in 1993. In contrast, the four-region common business cycle of job destruction switched from a high reduction regime to a moderate reduction regime in 1990 and then switched to a low reduction regime in 1993. The possible explanation is that the great Taiwanese bubble in 1990 had a large impact on the North Region and influenced the probability of the common business cycle switching between a high growth (reduction) regime and a moderate growth (reduction) regime.

Figure 8.10 The 4-region common business cycle of job creation and job destruction,1987-2003.

Panel 1 Job Creation MSI(3)-VAR(1)



Panel 2 Job Destruction MSI(3)-VAR(1)



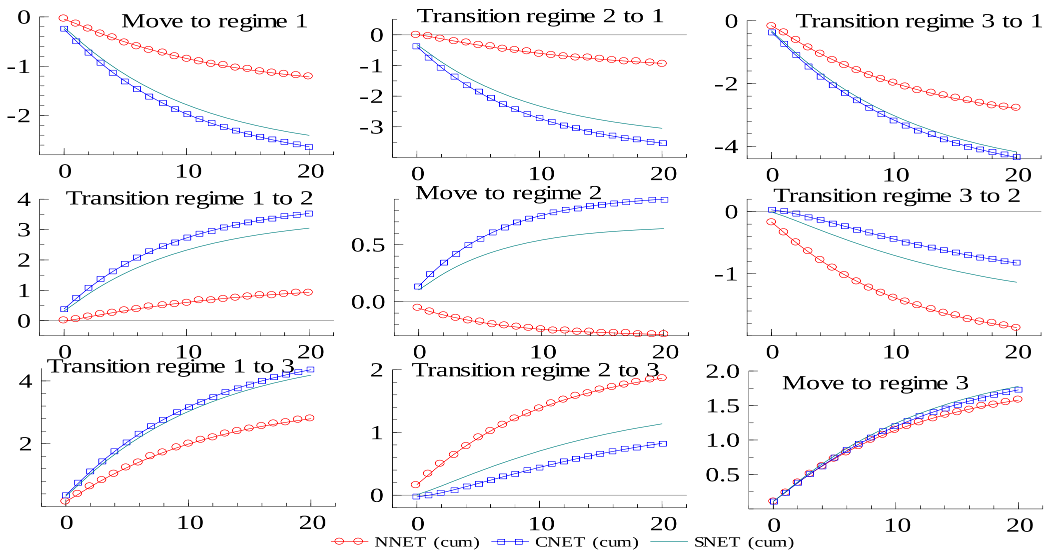
In summary, using the multivariate MS-VAR model a common regional business cycle of employment growth is identified, irrespective of whether or not the East Region is included. In particular, the regime switching behaviour of the common regional business cycle (specified in terms of employment growth) is consistent with the business cycle indicator used by the Council for Economic Planning and Development (CEPD). This finding suggests that the common regional business cycle would help to identify the turning point(s) after the 1990s. Also, we find that the regime switching behaviour of job creation seems to react to deep recession (December 2000-March 2002) earlier than that of job destruction. One possible explanation is that employers tend to reduce job creation and postpone additional job destruction in response to the need for employment adjustment due to an economic recession.

8.4 The effect of cyclical shocks across regions

The standard impulse response function (IRF) analysis focuses on the response of the system to Gaussian innovations. However, Krolzig and Toro (1998) introduce a dynamic approach whereby the system is shocked by a non-Gaussian innovation in the form of a regime change. Davis and Haltiwanger (1992) use the Longitudinal Research Datafile (LRD) data for the US manufacturing sector for the period 1979 to 1983 and find that recessions have a larger impact on job destruction than job creation.[25] Hence, it is interesting to compare the response of job creation and destruction to a ‘cyclical shock’ which leads to a regime shift from moderate growth to recession or vice versa.

Figure 8.11 shows the response of employment growth to a regime change. The non-linear impulse response analysis provides more insights with respect to labour market dynamics. Section 8.3 has shown that the common regional business cycle switched from the low growth regime to the moderate growth regime after the recession of December 2000 – March 2002. One interesting question is which region reacts (expands) first to the shock. Recall that Regime 1 denotes low growth (recession), Regime 2 is associated with the moderate growth, while Regime 3 represents high growth. As can seen in Figure 8.11, the Central Region responds strongly to the switch from a ‘low growth’ (recession) to a ‘moderate growth’ regime (regime 1 to 2), whereas the responses in the North and South Regions are slightly weaker. A likely explanation is that most of the Construction sector is clustered in the Central Region and this sector is typically a leading indicator of changes in the business cycle (see Chapter 5). Furthermore, we observe that the net employment growth rates across the three regions react positively to the ‘expansionary’ shock (Regime 1 to 3). In contrast, a ‘contractionary’ shock (Regime 3 to 1) leads to all regions responding negatively.

Figure 8.11 Response of net employment change to a regime shift

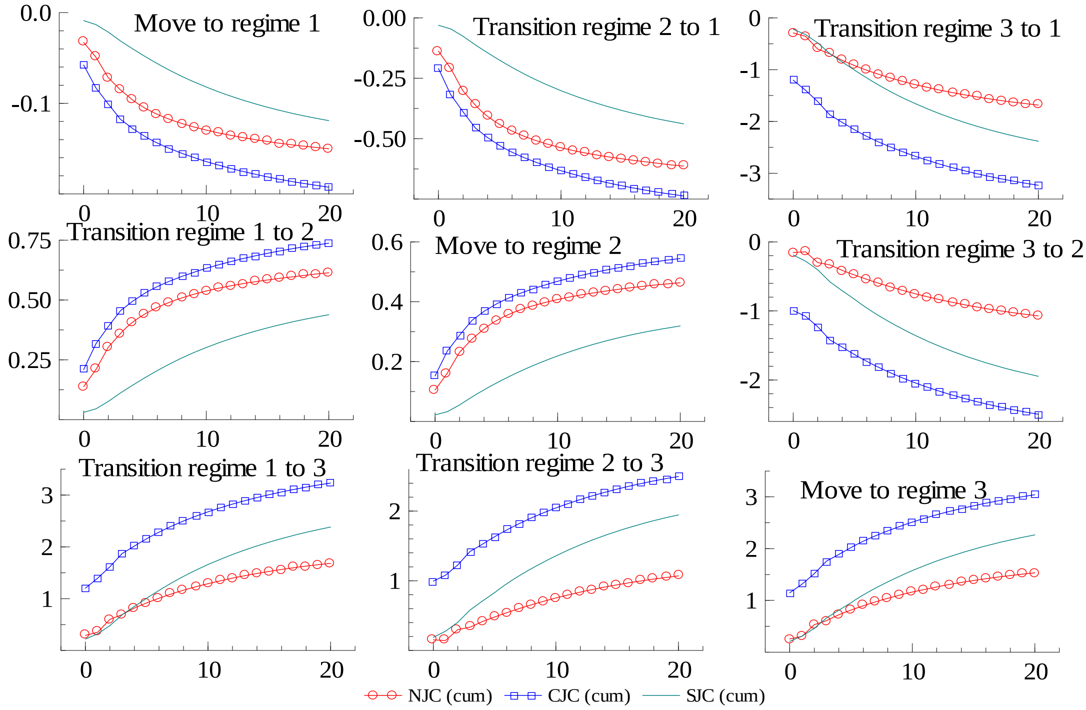


Notes: The vertical axis represents the change in the net employment growth rate. The horizontal axis represents months.

In order to gain further insights about the dynamics of employment growth, a non-linear impulse response was also employed for both job creation and destruction. Figures 8.12 and 8.13 show the response of rates of job creation and job destruction, respectively to a regime shift. In Figure 8.12, we observe that job creation rates in the three regions all react positively to an expansionary shock (say, Regime 1 to 2), and they all respond negatively to a contractionary shock (say, Regime 2 to 1). On the other hand, as can be viewed in Figure 8.13, job destruction rates in the three regions all react negatively to an expansionary shock (say, Regime 1 to 2). Meanwhile, a contractionary shock, such as the transitions from normal growth (Regime 2) to recession (Regime 1), leads to job destruction rates all responding positively

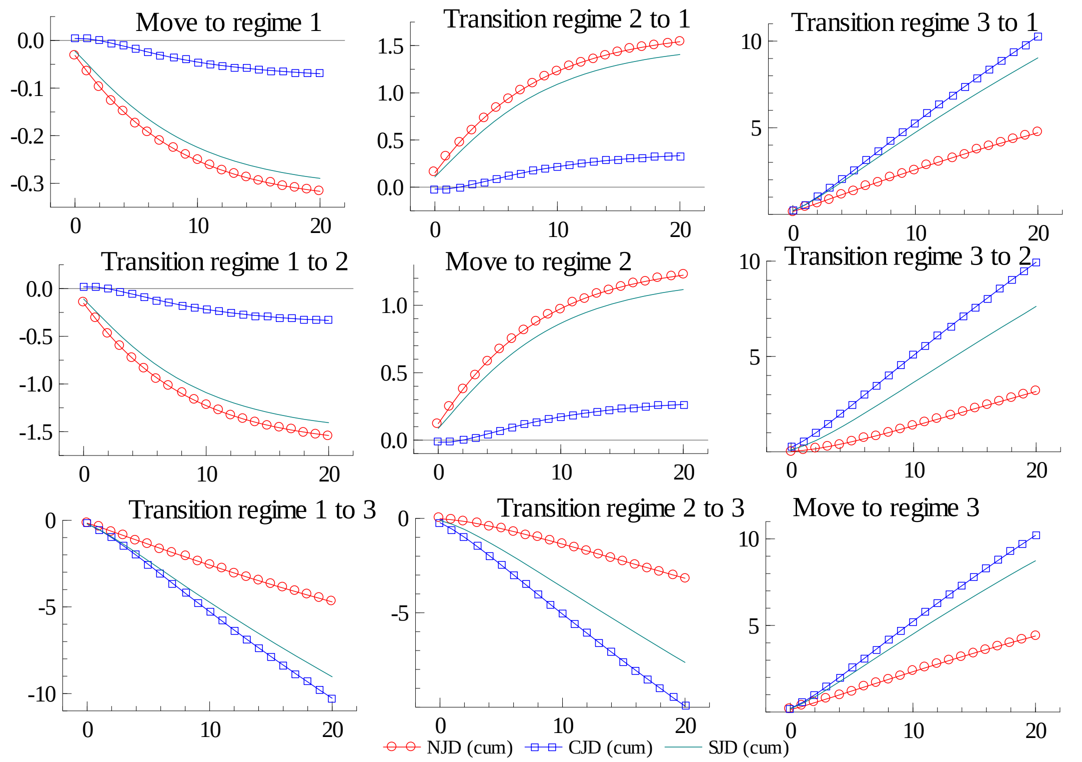
Also of interest are the relative magnitudes of job creation and destruction responses across the regions. Figure 8.12 shows that job creation responds relatively more strongly to an expansionary shock (Regime 1 to 2) in the Central Region than in the North or South Region. However, from the perspective of job destruction (see Figure 8.13), the Central Region exhibits more modest speeds of adjustment than the North or South Region in response to an expansionary shock, such as the transition from the recession regime to the normal growth regime (Regime 1 to 2). This evidence is consistent with the finding in Chapter 6 and the results presented by Tsou *et al.* (2002) for Taiwan. As a result, the combination of a strong reaction of job creation and a relative mild change in job destruction underpins a stronger recovery in the Central Region after a recession.

Figure 8.12 Response of job creation to a regime shift



Notes: The vertical axis represents the change in the job creation rate. The horizontal axis represents months.

Figure 8.13 Response of job destruction to a regime shift



Notes: The vertical axis represents the change in the job destruction rate. The horizontal axis represents months.

Moreover, the non-linear impulse response analysis provides a similar picture of the responses of the regions to a 'contractionary' shock. The reason is that the transition from moderate growth to recession is the mirror (negative) image of the response to a switching from recession to moderate growth (Clements and Krolzig, 2002). Net employment change in the Central Region reacts more strongly to the negative shock that the Central or South regions. This is largely driven by the strong negative reaction in job creation rates. This evidence contrasts to the US study by Davis and Haltiwanger (1992). One possible explanation is that the high cost of laying off workers may, over time, decrease the average rate of job destruction. The cost of sacking workers is not only redundancy pay but also the effect on morale and productivity if the establishment continues to recruit at a high rate, which engaging in high rates of job destruction. In addition, the 'contractionary' shock may lead to a reduction in 'voluntary' quits with job opportunities disappearing elsewhere, so that with a lower 'normal' rate of job destruction, a higher rate of sacking would be required if job creation was maintained. Thus, we can observe a relatively smooth job destruction rate and its relatively low sensitivity to a cyclical shock in Taiwan.

8.5 Conclusion

This Chapter has explored the business cycle characteristics of Taiwan's four core regions. This Chapter initial examined the similarities and differences in the business cycle across the regions. It was found that the regime switching behaviour of employment growth is similar among the North, Central and South regions. However, the behaviour in the East Region was dramatically different. The East Region is geographically isolated from the other three regions and has evolved into a distinctive regional economy with different industrial development and cultural background (Jiang and Liu, 2005). Based on graphical analysis, correlation coefficients, univariate Markov switching model, Pearson's contingency coefficient and Fisher's exact test, the evidence suggests the employment growth, job creation and destruction rates among North, Central, and South Regions are all highly correlated. The finding of strong co-movement between North, Central and South Regions suggests that aggregate stabilisation policies will be effective. On the other hand, the different cyclical behaviour of the East Region means that specific regional development politics managed by Taiwan government are probably required. If the aim is to achieve balanced regional development across the entire country, then a targeted industrial policy (for example, the formation and promotion of tourism policy) in the East Region merits a high priority.

This Chapter also examined the cyclical behaviour of the common regional business cycle and its connection to the national business cycle. Using the multivariate MS-VAR model, the regime switching behaviour of the common regional business cycle (specified in terms of employment growth) is consistent with the business cycle indicator developed by the Council for Economic Planning and Development (CEPD). This finding suggests that the common regional business cycle would help to identify the turning point after the 1990s. This finding also has important implications for the development of a business cycle indicator. An index of employment growth would appear to be a sound indicator of the timing of turning points in the business cycle. Using the employment growth index in combination with other indicators (for example, output growth) would help to monitor fluctuations of the aggregate economy.

Finally, based on the non-linear impulse response analysis, this Chapter found that the Central Region responds most strongly to cyclical shocks, whether expansionary or contractionary. Furthermore, we find that the combination of a strong reaction of job creation and a relatively mild response of destruction underpins a stronger response in the Central Region to ‘expansionary’ and ‘contractionary’ shocks. The possible explanation is that the ‘contractionary’ shock may lead to a reduction in ‘voluntary’ quits with job opportunities disappearing elsewhere, so that with a lower ‘normal’ rate of job destruction, a higher rate of sacking would be required if job creation were maintained.

Appendix A:

Table A.1 ARMA (p*,q*) Model[a] Selection Criteria for North Region

Job creation rate			Job destruction rate			Employment growth rate		
p,q	AIC	SC	p,q	AIC	SC	p,q	AIC	SC
8,8	-1.35	-1.06	8,8	-1.54	-1.26	8,8	-0.56	-0.28
8,6	-1.31	-1.06	8,6	-1.54	-1.29	8,6	**-0.59***	-0.34
8,4	-1.29	-1.07	8,4	**-1.56***	-1.34	8,4	-0.53	-0.31
8,3	-1.30	-1.10	8,3	-1.52	-1.32	8,3	-0.50	-0.29
8,2	-1.30	-1.12	8,2	-1.48	-1.29	8,2	-0.51	-0.32
8,1	-1.29	-1.12	8,1	-1.48	-1.32	8,1	-0.52	-0.35
6,8	-1.33	-1.09	6,8	-1.50	-1.25	6,8	-0.52	-0.27
6,6	-1.34	-1.12	6,6	-1.49	-1.27	6,6	-0.55	-0.33
6,4	**-1.37***	-1.19	6,4	-1.49	-1.31	6,4	-0.58	-0.40
6,3	-1.28	-1.11	6,3	-1.53	-1.36	6,3	-0.49	-0.32
6,2	-1.29	-1.14	6,2	-1.52	-1.38	6,2	-0.49	-0.34
4,8	-1.31	-1.10	4,8	-1.49	-1.27	4,8	-0.47	-0.26
4,6	-1.32	-1.14	4,6	-1.48	-1.30	4,6	-0.47	-0.29
4,3	-1.33	-1.19	4,3	-1.50	-1.35	4,3	-0.45	-0.30
4,2	-1.30	-1.17	4,2	-1.50	-1.37	4,2	-0.46	-0.33
4,1	-1.24	-1.13	4,1	-1.50	-1.39	4,1	-0.46	-0.35
3,3	-1.31	-1.15	3,3	-1.52	-1.40	3,3	-0.48	-0.36
3,2	-1.26	-1.16	3,2	-1.46	**-1.41***	3,2	-0.41	-0.32
2,2	-1.27	**-1.20***	2,2	-1.46	-1.38	2,2	-0.43	**-0.37***

Notes: [a] The lag order selected by the criterion is signed by *
AIC: Akaike information criterion; SC: Schwarz information criterion

Table A.2 ARMA (p*,q*) Model Selection Criteria for Central Region

Job creation rate			Job destruction rate			Employment growth rate		
p,q	AIC	SC	p,q	AIC	SC	p,q	AIC	SC
8,8	-0.85	-0.56	8,8	-0.94	-0.65	8,8	-0.09	0.19
8,6	-0.86	-0.61	8,6	-0.95	-0.70	8,6	**-0.10***	0.18
8,4	-0.82	-0.61	8,4	-0.90	-0.68	8,4	-0.05	0.19
8,3	-0.83	-0.63	8,3	-0.91	-0.71	8,3	0.06	0.26
8,2	-0.80	-0.62	8,2	-0.92	-0.74	8,2	0.05	0.23
8,1	-0.80	-0.63	8,1	-0.88	-0.71	8,1	0.04	0.21
6,8	-0.83	-0.58	6,8	-0.93	-0.68	6,8	0.04	0.29
6,6	**-0.86***	-0.64	6,6	**-0.99***	-0.77	6,6	0.02	0.24
6,4	-0.80	-0.62	6,4	-0.92	-0.74	6,4	0.08	0.26
6,3	-0.81	-0.64	6,3	-0.93	-0.77	6,3	0.07	0.24
6,2	-0.82	-0.67	6,2	-0.94	-0.79	6,2	0.17	0.32
4,8	-0.72	-0.51	4,8	-0.90	-0.69	4,8	0.02	0.23
4,6	-0.69	-0.50	4,6	-0.90	-0.72	4,6	0.02	0.20
4,4	-0.78	-0.64	4,4	-0.92	-0.77	4,4	0.10	0.24
4,2	-0.76	-0.63	4,2	-0.96	-0.8	4,2	0.04	**0.17***
4,1	-0.71	**-0.65***	4,1	-0.91	-0.79	4,1	0.16	0.28
3,3	-0.74	-0.63	3,3	-0.91	-0.79	3,3	0.16	0.28
3,2	-0.70	-0.60	3,2	-0.94	-0.84	3,2	0.18	0.28
2,2	-0.70	-0.62	2,2	-0.92	**-0.85***	2,2	0.16	0.24

Notes: see Table A.1

Table A.3 ARMA (p*,q*) Model[a] Selection Criteria for South Region

South region								
Job creation rate			Job destruction rate			Employment growth rate		
p,q	AIC	SC	p,q	AIC	SC	p,q	AIC	SC
8,8	**-0.72***	-0.44	8,8	-0.99	-0.70	8,8	-0.03	0.26
8,6	-0.52	-0.27	8,6	-1.03	-0.78	8,6	0.03	0.28
8,4	-0.52	-0.30	8,4	-1.01	-0.79	8,4	0.03	0.25
8,3	-0.53	-0.33	8,3	-1.02	-0.82	8,3	0.03	0.23
8,2	-0.46	-0.28	8,2	**-1.02***	**-0.83***	8,2	0.14	0.32
8,1	-0.47	-0.31	8,1	-0.92	-0.75	8,1	0.13	0.29
6,8	-0.59	-0.34	6,8	-1.00	-0.75	6,8	-0.01	0.24
6,6	-0.49	-0.28	6,6	-0.95	-0.73	6,6	**-0.03***	0.22
6,4	-0.56	-0.38	6,4	-0.96	-0.78	6,4	0.05	0.24
6,3	-0.53	-0.37	6,3	-0.96	-0.80	6,3	0.06	0.22
6,2	-0.53	-0.38	6,2	-0.93	-0.78	6,2	0.14	0.29
4,8	-0.45	-0.23	4,8	-0.98	-0.77	4,8	0.08	0.29
4,6	-0.46	-0.28	4,6	-0.94	-0.75	4,6	0.05	0.23
4,3	-0.55	-0.40	4,3	-0.93	-0.78	4,3	0.07	0.22
4,2	-0.57	-0.44	4,2	-0.94	-0.80	4,2	0.08	0.21
4,1	-0.47	**-0.45***	4,1	-0.94	-0.82	4,1	0.11	0.23
3,3	-0.41	-0.30	3,3	-0.91	-0.79	3,3	0.12	0.23
3,2	-0.43	-0.33	3,2	-0.90	-0.80	3,2	0.11	0.21
2,2	-0.44	-0.35	2,2	-0.88	-0.80	2,2	0.12	**0.20***

Notes: see Table A.1

Table A.4 ARMA (p*,q*) Model[a] Selection Criteria for East Region

Job creation rate			Job destruction rate			Employment growth rate		
P,q	AIC	SC	p,q	AIC	SC	p,q	AIC	SC
8,8	1.37	1.66	8,8	**0.89***	1.27	8,8	**1.70***	**2.09***
8,6	1.40	1.65	8,6	0.94	1.29	8,6	1.80	2.15
8,4	**1.22***	1.44	8,4	1.08	1.30	8,4	1.97	2.19
8,3	1.34	1.54	8,3	1.05	1.25	8,3	1.97	2.17
8,2	1.33	**1.43***	8,2	1.08	1.26	8,2	1.97	2.16
8,1	1.32	1.48	8,1	1.11	**1.23***	8,1	2.01	2.28
6,8	1.35	1.60	6,8	1.15	1.40	6,8	1.83	2.18
6,6	1.33	1.54	6,6	1.39	1.61	6,6	1.90	2.11
6,4	1.40	1.59	6,4	1.13	1.31	6,4	1.95	2.14
6,3	1.41	1.58	6,3	1.12	1.28	6,3	1.99	2.16
6,2	1.41	1.56	6,2	1.31	1.26	6,2	1.98	2.13
4,8	1.26	1.47	4,8	1.15	1.36	4,8	2.10	2.31
4,6	1.39	1.57	4,6	1.26	1.44	4,6	2.09	2.28
4,3	1.39	1.54	4,3	1.26	1.41	4,3	1.98	2.12
4,2	1.38	1.51	4,2	1.16	1.29	4,2	1.98	2.11
4,1	1.33	1.45	4,1	1.34	1.45	4,1	2.16	2.27
3,3	1.41	1.52	3,3	1.30	1.41	3,3	2.03	2.14
3,2	1.42	1.51	3,2	1.40	1.49	3,2	2.07	2.17
2,2	1.43	1.52	2,2	1.46	1.54	2,2	2.17	2.25

Notes: see Table A.1

Notes:

---

[1] The business cycle has been conceptualised by Burns and Mitchell (1946): 'Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organise their mainly in business cycle: a cycle consists of expansions occurring at about the same time in many activities, followed by similarly general recession, contractions, and revivals which merge into the expansion phase of the next cycle.' Hence, the business cycle is characterised by co-movements among a variety of economic variables.

[2] A number of spatial units are used for the study of regional business cycles, including countries, individual states, regions, metropolitan statistical areas (MSAs) and cities.

[3] A common regional business cycle is defined as economic activity commoving across regions. The common business cycle focuses on the common unobserved components of cycle and trend (Artis *et al.*, 2004). However, the only way that two series can be integrated is if they have a common trend (Greene, 2003).

[4] If two series $\{x_t, y_t\}$ are both I(1) that is stationary after using first differencing, then there may be a β such that $\varepsilon_t = y_t - \beta x_t$ is I(0) so that the error is stationary. Two series that satisfy this requirement are said to be co-integrated. In such a case, we can distinguish between a long-run relationship between y_t and x_t, that is, the manner in which the two variables drift upwards and downwards together, and the short-run dynamic, that is, the relationship of deviations of y_t and x_t from their respective long-run trends (Greene, 2003).

[5] For example, Hamilton (1989) uses GNP to study the US business cycle. Huang (1999) uses real GDP to explore the phases and characteristics of the Taiwanese business cycle.

[6] Phillips (1991) and Filardo and Gordon (1994) were the first studies of international business cycles using Markov-switching models.

[7] The Pearson's contingency coefficient is expressed as a percentage and corrected to take values in the range 0-100. A higher correlation implies a higher degree of concordance across countries. See more details in Chapter 6.

[8] These EU countries include Germany, France, Italy, Netherlands, Austria, Belgium, Spain, Portugal and UK.

[9] Koop *et al.* (1996) adopt a general impulse response analysis in non-linear models, which differs from the tradition impulse response analysis in terms of the condition information set (such as the business cycle is in the state of a boom or a recession at time *t*) and the type of shocks. Krolzig and Toro (1998) suggest a dynamic analysis that focuses on the system being subject to a non-Gaussian innovation, which can be interpreted as a cyclical shock. See more details in Krolzig and Toro (1998) and Chapter 6.

[10] For example, a regime switch from 'high growth' to 'low growth' can be identified with a 'recession' shock.

[11] The monitoring indicator covers nine variables, such as monetary aggregates M1B, non-agricultural employment, stock prices index, direct and indirect finance index, industrial production index, exports index, imports of machineries and electrical equipments, manufacturing sales and sales index of wholesale, retail and food services.

[12] The four regions cover 98 per cent of the total Taiwan economy apart from small islands such as Kinmen and Matsu.

[13] The East Region is isolated from the other three regions because the Central Mountain range is distributed from North to South in Taiwan.

[14] Jiang and Liu (2005) employ the Manpower database to explore the sources of the deterioration in employment in the four Taiwanese regions from 1987 to 2001. They find that the existing regional unemployment differentials were due to differences in industrial development, geographic location and cultural background. Furthermore, as

we have discussed in Chapter 2, the evolving pattern of industrial specialisation, which has reflected competitiveness and forces of agglomeration, has been complemented by government regional policy, to shape the distinctive patterns of economic growth across the four regional economies.

[15] To save space, we do not report the three-regime MSI model with higher AR order (such as 4, 5 and 6), which generate similar results as the MSI(3)-AR(2) and MSI(3)-AR(3) models.

[16] The likelihood ratio test statistic: $LR = -2(\lambda-\lambda_0)$ with an asymptotic Chi-square distribution, where λ and λ_0 denote the log-likelihood value of MSI(3)-AR(1) and MS(3)-AR(0) model, respectively. The likelihood ratio test statistic of the H_0: $\alpha_1=0$ against H_0: $\alpha_1\neq0$ is 0.4 and indicates rejection of the MSI(3)-AR(1) model.

[17] The likelihood ratio test statistic for a test of the MSI(3)-AR(0) model against the MSIH(3)-AR(0) model is $LR = -2[61.61 - 61.70] = 0.18$. The null hypothesis of homoscedastic errors is not rejected.

[18] All computations reported in this paper were carried out in OX 3.4, see H-M Krolzig workpage http://www.kent.ac.uk/economics/staff/hmk/.

[19] As we show in Table 8.2, the SC suggest the two-regime MSI(M)-AR(p) specification for the employment growth rates in the Central and South Regions. We denote Regime 1 as low growth and Regime 2 as normal growth, respectively. Thus, a high growth phase was not detected in these two regions.

[20] Since the MS-AR model could not identify significant regime switching behaviour in the East Region, Pearson's contingency coefficient and Fisher's exact test are only employed in North, Central and South Regions.

[21] Following Artis *et al.* (2004), in the MS-AR model with two regimes, 1 will denote contraction and 0 will denote expansion. However, in the three-regime model, the regimes correspond to recession, normal growth and high growth (for example, net

employment change in the North Region) 1 will denote recession. In contrast, 0 will denote normal growth regime and high growth regime.

[22] Selover *et al.* (2005) investigate the reasons behind this synchronisation of business cycles. They argue that trade between regions may not be strong enough for one region to "drive" the business cycle fluctuations in another region. They suggest that regional business cycles synchronise due to a nonlinear "mode-locking" process in which weakly coupled oscillating systems (regions) tend to synchronise. In contrast, this chapter focuses on the regime switching behaviour of the common regional business cycle.

[23] As we discussed in Chapter 2, there has been a wide range of factors, including government policy, the dynamics of industry specialisation and geography which have contributed to the distinct patterns of industrial development across these four regions (North, Central, South and East Regions) in Taiwan. For example, government regional policy has influenced the location of heavy industry in South Region and the promotion of the Tourism industry in East Region. Moreover, high-technology industry became established in North Region, light industry in the Central Region, heavy industry in the South Region and Tourism in the East Region and these industries have exploited the economics of agglomeration. Given this distinct pattern of regional economic development across these four regions, the following analysis (such as Multivariate Markov switching vector autoregression model) is based on that spatial disaggregation rather than the administrative geography defined by the seven main cities within the fifteen counties. This also provides a consistent basis for our empirical work given that the Shift-Share analysis (see Chapter 2), the univariate Markov switching autoregression model, Pearson's contingency coefficient and Fisher's exact test were all based on the four region geographical breakdown.

[24] Krolzig (1997) proposes a specification strategy for Markov-switching models of multiple time series. The pre-selection of the number of regimes M* can be obtained from the univariate MS-AR model analyses of each component of the time series vector. The autoregressive order p* is then based on the log-likelihood function and the macroeconomic fundamentals.

[25] As we have discussed in Chapter 5, the evidence of cyclical behaviour of job flows is mixed across countries. The greater volatility of job destruction than job creation is found in US and Norway (Davis and Haltiwanger, 1992; Boeri, 1996). In contrast, other research finds that the variance of job creation is larger than the variance of job destruction in Denmark, France, Italy, and Sweden (Wager, 1995; Contini *et al.*, 1995; Albak and Sorensen, 1998; Gourinchas, 1999; Persson, 2002). The differences in the cyclical behaviour of job flows between the US and the Western European may reflect differences associated with dismissal regulations.

Chapter 9 Conclusion

9.1 Summary of findings

This thesis has explored the behaviour of job flows in Taiwan. The investigation of the behaviour of job creation and destruction has improved our understanding of the dynamics of the Taiwanese labour market and also has important implications in terms of economic research and policymaking. In particular, this thesis employs a unique monthly dataset, which allows us to explore the dynamics of job creation and destruction over 1987-2003 from a variety of perspectives such as establishment size, industry sector and geographical location.

In Chapter 2, we discussed the basic features of the overall post-war Taiwanese economy. We found that large flows of workers enter and exit the employment pool. The large worker flows offer an interesting insight about the job flow dynamics. When a firm closes an establishment and destroys jobs, workers are forced to enter the unemployment pool or leave the labour force. When a firm creates jobs, workers may move from other firms or from the unemployment pool or from not in the labour force status to fill the positions.

Thus gross job flows are large relative to net employment changes. In Chapter 2, we also discussed the operation of the Public Service Employment Program and the Small and Medium Enterprises (SMEs) Manpower Project. The wage subsidy scheme for SMEs was unsatisfactory because of the high separation rate. This relatively unsuccessful preferential policy motivated us to investigate the hypothesis that small business outperforms large business with respect to job creation (and destruction) in Taiwan.

Based on the measures proposed in Chapter 3, Chapter 4 carefully examined the so-called small business job creation hypothesis. There are several significant findings. Firstly, previous studies reported results from two different versions of the small business job creation hypothesis, one of which was expressed in terms of a comparison of rates and the other in terms of a comparison of shares. The two versions of the small business job creation hypotheses can be reconciled, as long as we take account of the job creation (net job creation) share relative to its corresponding employment share. Secondly, we found that the base-size and current-size measures produce different results for the net job creation rate which is consistent with the results published by Davis *et al.* (1996a, 1996b). These discrepancies suggest that further investigation of the extent of bias in the calculation of gross and net job flows for small business was warranted. Thirdly, we also discovered that the number of inter-class plants is small. However, a large percentage of job creation and destruction is due to inter-class plants which suggest that the use of the base-size measure may involve significant regression bias. Furthermore, we discovered that in terms of job creation and destruction shares, the extent of regression bias of small business should be treated with caution. Finally, we found that the current-size measure largely addresses regression bias with respect to job creation and destruction treated separately. This suggests that it is a preferable method of dealing with regression bias given that the process involved in generating adjusted base-size measures is complex and time-consuming.

Turning from issues of measurement to substantive empirical matters, we found support for the small business job creation hypothesis across all three sectors in Chapter 4. Thus small business can be viewed as the engine of job creation. However, small business also destroys jobs in disproportionate numbers, which is revealed by the analysis of net job creation. Small business is not the source of sustained increases in employment, which is confirmed by the change in the size distribution of firms across the three sectors over the sample period. As a result, policy makers should be very cautious about adopting policies to address small business, particularly if implementing preferential policies.

In Chapter 5, we examined the basic features of job creation and job destruction based on a unique monthly dataset. We found that job creation is more volatile than job destruction in the manufacturing and service sectors, but reveals the opposite pattern in the construction sector; so that the results do not give very strong support the hypothesis of countercyclical job reallocation. Furthermore, the average share of worker turnover caused by job reallocation is 52 per cent in the manufacturing sector, while it is around 44 per cent and 80 per cent in the service and construction sectors, respectively. These results indicate that worker turnover in the service sector is more dynamic than in the manufacturing and construction sectors, which implies more efficient job matching in the former.

Chapter 5 also analysed the dynamics of worker turnover in Taiwan. We found that worker entry is dominated by new hires whereas worker exit is dominated by quits, and that this is consistent by sector and net employment change. Moreover, based on the Manpower Utilisation Survey, we found that the main reasons for job changers leaving their last jobs are low pay and the expectation of workplace closure or business downsizing. Finally, the high rate of voluntary worker turnover (quits) was found even in declining plants which suggest that employees may not be voluntary.

Based on the econometric and statistical methods methodologies outlined in Chapter 6, Chapter 7 investigated the regime switching and asymmetric behaviour of job creation and destruction in the Taiwanese manufacturing, service, and construction sectors during the period 1987 to 2003. Using the MS-AR model-based test, we found evidence of positive steepness in the job destruction rate in the manufacturing sector and negative steepness of the job creation rate in the service sector. Moreover, evidence of sharpness is found in the job destruction rate in the construction sector. These results suggest that some phases of regime switching behaviour in these three sectors are different from the mirror image of the opposite phase (Sichel, 1993).

In Chapter 7, based on the MSIH(M)-ARX(p) model with an exogenous variable which proxies monetary policy changes (the discount rate), we further found that the discount rate can help to explain the asymmetric behaviour of job creation and destruction rates in all sectors. Importantly, we found that the lower discount rate stimulated beneficial regime shifts in job flows. This coincidence in time does not directly prove the impact of monetary policy (the discount rate) on job creation and destruction. We do not deny the possibility that the easing of monetary policy was associated with other factors which also promoted the beneficial regime shifts. We thus tentatively conclude that discretionary monetary policy in Taiwan has a significant influence on the cyclical behaviour of job creation and destruction. As a result, these findings suggest that monetary policy may be an efficient instrument in stimulating the labour market during periods of recession but should be executed with caution in fighting inflation and slowing economic growth in a boom.

Chapter 8 explored the business cycle characteristics of Taiwan’s four core regions. The work has some implications for the dating of business cycles and policymaking. This Chapter found that the regime switching behaviour of employment growth was similar across the North, Central and South regions. However, behaviour in the East Region was dramatically different. This could be because the East Region is geographically isolated from the other three regions and has evolved into a distinctive regional economy with different pattern of industrial development and cultural background (Jiang and Liu, 2005). Based on graphical analysis, correlation coefficients, univariate Markov switching model, Pearson’s contingency coefficient and Fisher’s exact test, the evidence suggests the employment growth, job creation and destruction rates among North, Central, and South Regions are all highly correlated. From a policymaking perspective, the finding of co-movement between North, Central and South Regions suggests that aggregate stabilisation policies will be effective. On the other hand, the different cyclical behaviour of the East Region means that specific regional development politics managed by Taiwan government are probably required. If the aim is to achieve balanced regional development across the entire country, then a targeted industrial policy (for example, the formation and promotion of tourism policy) in the East Region merits a high priority.

Chapter 8 also examined the cyclical behaviour of the common regional business cycle and its connection with the business cycle indicator proposed by Council for Economic Planning and Development (CEPD). Based in the multivariate MS-VAR model, we found that regional business cycle based on three of the four regions is governing the national business cycle. Furthermore, the regime switching behaviour of the common regional business cycle (specified in terms of employment growth) is consistent with CEPD business cycle indicator. This finding suggests the common regional business cycle would help to identify the turning points after 1990s. This finding also has crucial implication for the development of business cycle indicators. The index of employment growth would appear to be a sound indicator of the timing of turning points in the business cycle. Using the employment growth index in combination with other indicators (for example, output growth) would help to monitor fluctuations of the aggregate economy.

In conclusion, the results presented in this thesis have provided conceptual insights into the operation of the Taiwanese labour market by contributing to the literature on job creation and destruction in terms of the small business job creation hypothesis, the extent of regression bias of small business, the connection between job reallocation and worker turnover, the relationship between monetary policy and asymmetric behaviour of job flows, and the characteristics of region business cycles in Taiwan. These empirical results have implications for policymaking.

9.2 Limitations of the research

This section collates limitations due to data and model development. We initially discuss the limitations of data that require further appropriate data and empirical analysis and followed by the limitations of models that employed in this thesis. There are four issues in regard to data and models limitations in this thesis.

9.2.1 Job flows due to new or exiting plants

One limitation of this study is that it is unable to examine the contribution of entry and exit of plants to job flows, because the data of new plants or exiting plants is not available. The behaviour of new plants and exiting plants can shed hight about their contribution over the evolution of industry. Moreover, with the data of new plants the examination of creative destruction theory could be undertaken more rigorously. The development of better longitudinal data for new businesses merits a high priority by Taiwanese government statistical agencies which will assist in better understanding the dynamics of small businesses.

9.2.2 Involuntary quits

In Chapter 5, we have found that quits most strongly contribute to worker exit. In contrast, layoffs play little role in involuntary exits. In fact, this is empirically a ‘grey area’ because we cannot infer whether a separation is initiated by employees or employers (Hassink, 2000). The employer can influence resignations by informing workers of the likelihood of being sacked and advising them to seek other employment. Unfortunately, given the data limitations we were unable to investigate the voluntary and involuntary components of quits in more detail. The collection of more informative data on quits merits consideration by the Taiwanese government statistical agencies.

9.2.3 Limitation in Markov-switching models

9.2.3.1 Time-varying transition probability

The main methodology of this thesis is the Markov-switching autoregressions (MS-AR) model. Moreover, the univariate MS-AR model is extended to multivariate settings. One limitation of the MS-AR model employed in this thesis is that the transition probabilities are time-invariant; that is, the probability of switching from one regime to another cannot depend on the behaviour of underling economic fundamentals. A number of authors (Diebold *et al.,* 1993; Filardo, 1994; Filardo and Gordon, 1998; Mariano *et al.*, 2004; Masson and Ruge-Murcia, 2005) employ MS-AR model with time-varying transition probabilities.

Using time-varying transition probabilities researchers and policy makers are able to determine if a country is heading for economically difficult (or good) times. Based on the Markov-switching model with time-varying transition probabilities, Filardo and Gordon (1998) find that the expected duration of a recession tend to fall off quickly near the end of the recession, hence signalling an upcoming change in the regime of expansion. In Chapter 8, we found that the common regional business cycle (specified in terms of employment growth) generated by MS-VAR model with fixed transition probabilities roughly corresponds to the timing of the business cycle based on monitoring with expansions and contractions occurring at approximately the same times as indicated by the CEPD. As a result, it is interesting to investigate how the expected duration of the common regional business cycle change over the recession period by using the time-varying Markov-switching model.

9.2.3.2 Markov-Switching Structural Vector Autoregressions

Over the last five years, the Markov-switching model has been extensively applied and also extended in a number of directions, including Markov switching stochastic frontier models (Tsionas and Kumbhakar, 2004); Markov switching GARCH models (Haas *et al.*, 2004); and Markov switching structural vector autoregressions (MS-SVARs) (Juan *et al.*, 2005). Prioritising each of the above approaches for further research is difficult since each method extend the limitation of the basic MS-AR model in different directions. For example, Haas *et al.* (2004) relax the limitation of constant variance within regimes in the basic MS-AR model, which allow one to explore the different volatility processes in expansionary and contractionary periods, respectively.

Recently, Juan *et al.* (2005) extend the basic MS-AR model to Markov-switching SVARs by putting prior restrictions on the diagonal of the transition matrix. They also develop an efficient algorithm for Markov-switching SVARs identified with short-run and long-run restrictions. Moreover, they apply the MS-SVAR model to the Euro area data by using four identification schemes. Juan *et al.* (2005) find that the impact of monetary policy shocks is small and uncertain across models and regimes. Since Chapter 7 found that the change of monetary policy can help to explain the asymmetric behaviour of job creation and destruction in manufacturing, service, and construction sectors, it would be interesting to investigate the impact of a monetary policy shock across sectors or regions by using the MS-SVAR model.

References:

Abowd, J.M., Corbel, P., and Kramarz, F., (1999) 'The Entry and Exit of Workers and the Growth of Employment: An Analysis of French Establishments', *Review of Economics and Statistics*, 81(2), 170-187.

Acs, Z.J., Armington, C., and Robb, A., (1999) 'Measures of Job Flow Dynamics in the U.S.', *Working Paper* No 99-1, Center for Economic Studies, USA.

Aghion, P. and Howitt, P. (1992) 'A Model of Growth through Creative Destruction', *Econometrica,* 60(2), 323-351.

Agresti, A. (1996) *An introduction to categorical data analysis,* Wiley Press, New York.

Albæk, K., and Sorensen, B.E., (1998) 'Worker Flows and Job Flows in Danish Manufacturing - 1980-91', *Economic Journal*, 108 (11), 1750-1771.

Anas, A., Arnott, R. and Small, K.A. (1998) 'Urban Spatial Structure', *Journal of Economic Literature*, 36(3), 1426-1464.

Anderson, P.M., and Meyer, B.D. (1994) 'The Extent and Consequences of Job Turnover', *Brookings Papers on Economic Activity - Microeconomics*, 1994(2), 177-248.

Andolfatto, D., Hendry, S. and Moran, K., (2004) 'Labour Markets, Liquidity, and Monetary Policy Regimes', *Canadian Journal of Economics*, 37(2), 392-420.

Artis, M., Krolzig, H.M. and Toro, J. (2004) 'The European Business Cycle', *Oxford Economic Papers*, 56(1), 1-44.

Askenazy, P. and Moreno G.E. (2007) 'The Impact of Technological and Organizational Changes on Labor Flows: Evidence on French Establishments', *Labour*, 21(2), 265-301.

Ash, B.Y. (1968) ‘The Shift-Share analysis: A Reply’, *Southern Economic Journal*, 33(1), 423-425.

Asia-Pacific Economic Cooperation (APEC) (2002) *The Profile of SMEs and SME Issues in APEC 1990 – 2000,* World Scientific Press, Singapore.

Australian Bureau of Statistics (ABS) (2003) *National Accounts.*

Baldwin, J., Dunne, T., and Haltiwanger, J. (1998) ‘A Comparison of Job Creation and Job Destruction in Canada and the United States’, *Review of Economics and Statistics*, 80(3), 347-356.

Baldwin, J. and Picot, G. (1995) ‘Employment Generation by Small Producers in the Canadian Manufacturing Sector’, *Small Business Economics*, 7(4), 317-331.

Ball, L.M., and Sheridan, N., (2003) ‘Does Inflation Targeting Matter?’, *Working Paper* 03-129, International Monetary Fund (IMF).

Barro, R. and Gordon, D. (1983a) ‘Rules, Discretion and Reputation in A model of Monetary Policy’, *Journal of Monetary Economics*, 12(1), 101-121.

Barro, R. and Gordon, D. (1983b) ‘A Positive Theory of Monetary Policy in A Natural Rate Model’, *Journal of Political Economy*, 91(4), 589-610.

Basile, A. and Joyce, J., (2001) ‘Asset Bubbles, Monetary Policy and Bank Lending in Japan: An Empirical Investigation,’ *Applied Economics*, 33(13), 1737-1744.

Beaudry, P. and Koop, G. (1993) ‘Do Recessions Permanently Change Output?’, *Journal of Monetary Economics*, 31(2), 149-163.

Bernanke, B.S. and Blinder, A. (1992) ‘The Federal Funds Rate and the Channels of

Monetary Transmission', *Economic Review*, 82(4), 901-921.

Bernanke, B.S. and Boivin, J. (2003) 'Monetary Policy in a Data-Rich Environment', *Journal of Monetary Economics*, 50(3), 525-546.

Birch, D.L. (1979) *The Job Generation Process*, Unpublished report prepared by the Massachusetts Institute of Technology Program on the Neighbourhood and Regional Change for the Economic Development Administration, Department of Commerce, Washington, D.C., USA.

Black, F. (1982) General Equilibrium and Business Cycles, *Working Paper* No. 920, National Bureau of Economic Research (NBER), USA.

Blanchard, O.J. and Diamond, P. (1990) 'The Cyclical Behaviour of the Gross Flows of U.S. Workers', *Brookings Papers on Economic Activity*, 1990(2), 85-143.

Bliss, C. (1999) 'Galton's Fallacy and Economic Convergence', *Oxford Economic Paper*, 51(1), 4-14.

Bluedorn, A.C. (1978) 'A taxonomy of turnover', *Academy of Management Review*, 12(3), 647-651.

Bockerman P. and Maliranta, K. (2001) 'Regional Disparities in Gross Job and Worker Flows in Finland', *Finnish Economic Papers*, 14(2), 84-103.

Bodman, P.M., (2001) 'Steepness and Deepness in the Australian Macroeconomy', *Applied Economics*, 33(3), 375-82.

Boeri, T. (1994) 'Why Are Establishments So Heterogeneous? Entry, Exit and Gross Job Reallocation in Germany', *Small Business Economics*, 6(3), 409-420.

Boeri, T. (1996) 'Is job countercyclical?', *Journal of Labor Economics*, 14(4), 603-625.

Bonser, N.C., Roley, V. and Sellon, G., (1998) 'Monetary policy actions, intervention and exchange rates: A reexamination of the empirical relationships using federal funds rate target data,' *Journal of Business*, 71(2), 147-177.

Borland, J. (1996) 'Job Creation and Job Destruction in Manufacturing Industry in Australia', *Economic Record*, 72(216), 46-62.

Borland, J. and Home, R. (1994) 'Establishment-level Employment in Manufacturing Industry: Is Small Really Beautiful?', *Australian Bulletin of Labour*, 20(2), 110-128.

Brailsford, T., Penm, J.H. and Lai, C.D., (2006) 'Effectiveness of High Interest Rate Policy on Exchange Rates: a Re-examination of the Asian Financial Crisis', *Journal of Applied Mathematics and Decision Sciences*, 12(1), 1-9.

Broersma, L. and Gautier, P. (1997) 'Job Creation and Job Destruction by Small Firms: An Empirical Investigation for the Dutch Manufacturing Sector', *Small Business Economics*, 9(3), 211-224.

Burns, A.F., and Mitchell, W.C., (1946) '*Measuring Business Cycles'*, National Bureau of Economic Research (NBER), USA.

Caballero, R.J. and Hammour, M.L. (1994) 'The Cleansing Effect of Recessions', *American Economic Review*, 84(5), 1350-1368.

Caballero, R.J. and Hammour, M.L. (1996) 'On the Timing and Efficiency of Creative Destruction', *Quarterly Journal of Economics*, 111(3), 805-852.

Campbell, J.R. and Fisher, J.D. (2000) 'Aggregate Employment Fluctuations with Microeconomic Asymmetries', *American Economic Review*, 90(5), 1323-1345.

Cannon, E.S. and Duck, N.W. (2000) 'Galton's Fallacy and Economic Convergence', *Oxford Economic Paper*, 52(2), 415-419.

Cappelli, P. and Neumark, D. (2001) ‘External Job Churning and Internal Job Flexibility’, *Working Paper* No: 8111, National Bureau of Economic Research (NBER), USA.

Carlino, G. and Keith, S. (1998) ‘The Cyclical Behaviour of Region Per Capital Incomes in the Post-war Period’, *Working Paper* No: 98-11, Federal Reserve Bank of Philadelphia, USA.

Carlino, G. and Keith, S. (2000) ‘Regional Income Fluctuation: Common Trends and Common Cycles’, *Working Paper* No: 00-8, Federal Reserve Bank of Philadelphia, USA.

Carree, M. and Klomp, L. (1996) ‘Small Business and Job Creation: A Comment’, *Small Business Economics,* 8(4), 317-322.

Chadha, J.S. and Nolan, C. (2007) ‘Optimal Simple Rules for the Conduct of Monetary and Fiscal Policy’, *Journal of Macroeconomics*, 29(4), 665-689.

Champion, S.R. (1998) *The Great Taiwan Bubble: the rise and fall of an emerging stock market,* Pacific View Press, Berkeley.

Chang, S.H. (2004) ‘Taiwan's Business Cycles: Money and Wage Contracts in a Small Open Economy’, *Taiwan Economic Review,* 32(1), 25-61. (In Chinese)

Chauvet, M., Juhn, C. and Lima, E.C. (2002) ‘Markov Switching in Disaggregate Unemployment Rates’, *Empirical Economics*, 27(2), 205-232.

Chen, P.S. (1997) *The Trend Study of Construction Business in Taiwan*, Master Thesis, National Taiwan University of Science and Technology, Taiwan. (In Chinese)

Chen, S.W. and Lin, J.L. (2000) ‘Identifying Turning Points and Business Cycles in Taiwan: A Multivariate Dynamic Markov - Switching Factor Model Approach’, *Academia Economic Papers*, 28(3), 289-320.

Chen, S.W. (2001) ‘A Note on Taiwan's Business Chronologies in Terms of the Markov-Switching Factor Model’, *Taiwan Economic Review*, 29(2), 153-176.

Chen, S.W. (2002) ‘Is There a Peak-Reversion Asymmetry in Taiwan's Business Cycles?’, *Taiwan Economic Review*, 30(4), 531-562.

Chen, S.W. and Shen C.H. (2006) ‘Can the Identification Puzzle of Taiwan's Turning Points after 1990 be Solved?’, *Economic Modelling*, 23(1), 174-195.

Chiao, C. and Hung, W. (2006) ‘Stock Market Valuations of R&D and Electronics Firms during Taiwan's Recent Economic Transition’, *Developing Economies*, 44(1), 53-78

Christopoulos, D.K. (2004) ‘Currency devaluation and output growth: new evidence from panel data analysis’, *Applied Economics Letters*, 11(13), 809-813.

Clarida, R., Gertler, M. and Gali, J., (1999) ‘The Science of Monetary Policy: A New Keynesian perspective’, *Journal of Economic Literature,* 37(2), 1661-1707.

Clark, T. (1992) ‘Business Cycle Fluctuations in U.S. Regions and Industries: The Roles of National, Region-Specific, and Industrial-Specific Shocks’, *Working Paper* No: 92-05, Federal Reserve Bank of Kansas City, USA.

Clark, T. and Eric, V.W. (1999) ‘Borders and Business’, *Working Paper* No: 99-05, Federal Reserve Bank of Kansas City, USA.

Clements, M.P. and Krolzig, H.M. (2002) ‘Can Oil Shocks Explain Asymmetries in the US Business Cycle?’, *Empirical Economics*, 27(2), 185-204.

Clements, M.P. and Krolzig, H.M. (2003) ‘Business Cycle Asymmetries: Characterization and Testing Based on Markov-Switching Autoregressions’, *Journal of Business and Economic Statistics*, 21(1), 196-211.

Contini, B. (1995) ‘Job Creation and Destruction in Italy’, *Studies in the Modern World Economy*, 3(2), 195-215.

Cologin, A., and Manera, M. (2006) ‘The Asymmetric Effects of Oil Shocks on Output Growth: a Markov-Switching Analysis for the G-7 Countries’, *Working Paper* 06-29, Fondazione Eni Enrico Mattei, Italy.

Council for Economic Planning and Development (CEPD) (2008), *Taiwan Business Indicators in 2007*, Press Release, February 3, 2008.

Council of Labour Affairs (CLA) (2004) *Labour Statistics,* Taiwan.

Council of Labour Affairs (CLA) (2007) *Labour Statistics,* Taiwan.

Cover, J.P., Hueng, C.J. and Yau, R. (2002) ‘Are Policy Rules Better Than the Discretionary System in Taiwan?’, *Contemporary Economic Policy*, 20(1), 60-71.

Crone, T. (1999) ‘Using State Indexes to Define Economic Regions in the U.S.’, *Working Paper* No. 99-19, Federal Reserve Bank of Philadelphia, USA.

Cunningham, N.J. (1969) ‘A Note on the 'Proper Distribution of Industry'’, *Oxford Economic Papers,* 21(1), 122-127.

Dalenius, T. and Hodges, J.L. (1959) ‘Minimum Variance Stratification,’ *Journal of the American Statistical Association*, 54(1), 88-101.

Dalton, D.R. and Krackhardt, D.M. and Porter, L.W. (1981) ‘Functional Turnover: An Empirical Assessment’, *Journal of Applied Psychology*, 66(6), 716-721.

Davis, S.J. and Haltiwanger, J. (1990) ‘Gross Job Creation and Destruction: Microeconomic Evidence and Macroeconomic Implications’, *NBER macroeconomics annual,* 5, 123-168.

Davis, S.J. and Haltiwanger, J. (1992) ‘Gross Job Creation, Gross Job Destruction, and Employment Reallocation’, *Quarterly Journal of Economics*, 107(3), 819-863.

Davis, S.J., Haltiwanger, J. and Schuh, S. (1996a) ‘Small Business and Job Creation: Dissecting the Myth and Reassessing the Facts’, *Small Business Economics*, 8(4), 297-315.

Davis, S.J. Haltiwanger, J. and Schuh, S. (1996b) *Job Creation and Destruction*, MIT Press, Cambridge, Massachusetts, USA.

Davis, S.J. and Haltiwanger, J. (1999a) ‘Gross Job Flows’, *Handbook of Labor Economics*, 3, 2711-2805, Elsevier Science Press, Amsterdam.

Davis, S.J. and Haltiwanger, J. (1999b) ‘On the Driving Forces Behind Cyclical Movements in Employment and Job Reallocation’, *American Economic Review*, 89(5), 1234-1258.

Davis, S.J. and Haltiwanger, J. (2001) ‘Sectoral Job Creation and Destruction Responses to Oil Price Changes’, *Journal of Monetary Economics*, 48(3), 465-512.

Davis, S. J. Faberman, R.J. and Haltiwanger, J. (2006) ‘The Flow Approach to Labor Markets: New Data Sources and Micro-Macro Links, *Journal of Economic Perspective*, 20(3), 3-26.

Davidsson, P., Lindmark, L. and Olofsson, C. (1998) ‘The Extent of Overestimation of Small Firm Job Creation- An Empirical Examination of the Regression Bias’, *Small Business Economics*, 11(1), 87-100.

Delfgaauw, J. (2007) ‘Where to Go? Workers' Reasons to Quit and Intra- vs. Interindustry Job Mobility’, *Applied Economics*, 39(16), 2057-2067.

Dekle, R. (1998) ‘The Yen and Japanese Manufacturing Employment’, *Journal of International Money and Finance*, 17(5), 785-801.

DeLong, B. and Summers, L. (1988) ‘How Does Macroeconomic Policy Affect Output?’, *Brooking Paper on Economic Activity*, 1988(2), 433-494.

Dempster, A.P. Laird N.M. and Rubin D.B. (1977) Maximum Likelihood from Incomplete Data via the EM Algorithm’, *Journal of the Royal Statistical Society, Series B (Methodological)*, 39(1), 1-38.

Dickinson D. and Liu J., (2007) ‘The Real Effects of Monetary Policy in China: An Empirical Analysis,’ *China Economic Review*, 18(1), 87-111.

Diebold, F.X., Lee, J.H. and Weinbach, G.C. (1994) ‘Regime Switching with Time-Varying Transition Probabilities”, *Advanced Texts in Econometrics*, Oxford University Press, Oxford, 283-302.

Diebold, F.X., Rudebusch, G.D., and Sichel, D.E. (1993) ‘Further Evidence on Business-Cycle Duration Dependence Business cycles, indicators, and forecasting’, *NBER Studies in Business Cycles*, University of Chicago Press, Chicago, 255-280.

Diebold, F.X. and Rudebusch, G.D. (1996) ‘Measuring Business Cycles: A Modern Perspective’, *Review of Economics and Statistics*, 78(1), 67-77.

Directorate General of Budget, Accounting and Statistics (DGBAS) (2003) *National Statistics*, Taiwan.

Directorate General of Budget, Accounting and Statistics (DGBAS) (2004) *National Statistics*, Taiwan.

Directorate General of Budget, Accounting and Statistics (DGBAS) (2006) *National Statistics*, Taiwan.

Directorate General of Budget, Accounting and Statistics (DGBAS) (2005) *National Statistics*, Taiwan.

Directorate General of Budget, Accounting and Statistics (DGBAS) (2007) *Employment Turnover Statistics*, Taiwan.

Directorate General of Budget, Accounting and Statistics (DGBAS) (2008) *National Statistics,* Taiwan.

Ding, D.K., Chua, J.L. and Fetherston, T.A., (2005) 'The Performance of Value and Growth Portfolios in East Asia before the Asian Financial Crisis', *Pacific-Basin Finance Journal*, 13(2), 185-199.

Drnovsek, M. (2004) 'Job Creation Process in a Transition Economy', *Small Business Economics*, 23(3), 179-188.

Emery, R. F. (1987) 'Monetary policy in Taiwan, China', *International Finance Discussion Paper* No: 313, Board of Governors of the Federal Reserve System, USA.

Engle, R.F. and Granger, C.W. (1987) 'Cointegration and Error Correction: Representation, Estimation, and Testing', *Econometrica,* 55(2), 251-276.

Engel, C. and Hamilton J. D. (1990) 'Long swings in the dollar: Are they in the data and do markets know it?', *American Economic Review*, 80(3), 689-713.

ENSR (1995) '*The European Observatory for SMEs*', Third Annual Report, Zoetermeer: EIM Small Business Research and Consultancy/European Network for SME Research.

Erlinghagen, M. and Knuth, M. (2004) 'The Evolution of Labour Market Dynamics in West Germany from the Doom of Industrialism to the Dawn of the Service Economy', *Economia e Lavoro*, 38(1), 91-113.

Essletzbichler, J. (2004) ‘The Geography of Job Creation and Destruction in the U.S. Manufacturing Sector, 1967–1997’, *Annals of the Association of American Geographers*, 94(3), 602-619.

Essletzbichler, J. (2007) ‘The Geography of Gross Employment Flows in British Manufacturing’, *European Urban and Regional Studies*, 14(1), 7-26.

Fahr, R. and Sunde, U. (2004) ‘Occupational Job Creation: Patterns and Implications’, *Oxford Economic Papers*, 56(3), 407-435.

Fahr, R. and Sunde, U. (2006) ‘Regional Dependencies in Job Creation: An Efficiency Analysis for Western Germany’, *Applied Economics*, 38(10), 1193-1206.

Filardo, A.J. (1994) ‘Business-Cycle Phases and Their Transitional Dynamics’, *Journal of Business and Economic Statistics*, 12(3), 299-308.

Filardo, A.J. and Gordon, S.F. (1998) ‘Business Cycle Durations’, *Journal of Econometrics*, 85(1), 99-123.

Fisher, R.A. (1934) ‘The Logic of Inductive Inference’, *Journal of Royal Statistics Society*, Series A 98, 39-54.

Florio, A. (2005) ‘Asymmetric Monetary Policy: Empirical Evidence for Italy’, *Applied Economics*, 37(7), 751-764.

Freeman, S., Hong, D. P., and Peled, D., (1999) ‘Endogenous Cycles and Growth with Indivisible Technological Developments’, *Review of Economic Dynamics*, 2(2), 403-432.

Friedman, M. (1968) ‘The Role of Monetary Policy’, *American Economic Review*, 58(1), 1-17.

Friedman, M. (1969) *The optimum quantity of money and other essays*, Aldine Press, Chicago.

Friedman, M. (1992) 'Do Old Fallacies Ever Die?', *Journal of Economics Literature*, 30(4), 2129-2132.

Fuchs, V.R. (1962) 'Statistical Explanations of Relative Shift of Manufacturing among Regions of the U.S.', *Papers Regional Science Association*, 8(1), 105-126.

Fullwiler, S.T. (2007) 'Interest Rates and Fiscal Sustainability', *Journal of Economic Issues*, 41(4), 1003-1042.

Galton, F. (1886) 'Regression Towards Mediocrity in Hereditary Stature', *Journal of the Anthropological Institute*, 15(2), 246-263.

Garcia, R. (1998) 'Asymptotic null distribution of the likelihood ratio test in Markov switching models', *International Economic Review*, 39(3),763-788

Garibaldi, P. (1997) 'The Asymmetric Effects of Monetary Policy on Job Creation and Destruction', *Working Paper* No: 97-57, International Monetary Fund (IMF).

Garcia, R. and Perron P. (1996) 'An analysis of the real interest rate under regime shifts', *Review of Economics and Statistics*, 78(1), 111-125.

Geman, S. and Geman, D. (1984) 'Stochastic Relaxation, Gibbs Distributions, and the Bayesian Restoration of Images', *IEEE Transaction on Pattern Analysis and Machine Intelligence*, 6(11), 721-741.

Genda Y. (1998) 'Job Creation and Destruction in Japan, 1991-1995', *Journal of the Japanese and International Economies*, 12(1), 1-23.

Gentry, W.M. and Hubbard, R.G. (2004) 'Success Taxes, Entrepreneurial Entry, and Innovation', *Working Paper* No: 10551, National Bureau of Economic Research (NBER), USA.

Goldfajn, I. and Baig, T. (2002) ‘Monetary policy in the aftermath of currency crises: the case of Asia’, *Review of International Economics*, 10(1), 92-112.

Goncalves, C.S. and Carvalho, A. (2008) ‘Who Chooses to Inflation Target?’, *Economics Letters*, 99(2), 410-413.

Goodfriend, M. (2007) ‘How the World Achieved Consensus on Monetary Policy’, *Journal of Economic Perspectives*, 21(4), 47-68.

Goolsbee, A. (1998) ‘Taxes, Organizational Form and the Deadweight Loss of the Corporate Income Tax’, *Journal of Public Economics*, 69(1), 143-152.

Goolsbee, A. (2004) ‘The Impact of the Corporate Income tax: Evidence from State Organizational Form Data,’ *Journal of Public Economics*, 88(11), 2283-2299.

Goodwin, T.H. and Sweeney, R.J. (1993) ‘International Evidence on Friedman's Theory of the Business Cycle’, *Economic Inquiry*, 31(2), 178-193.

Gourinchas, P.O. (1999) ‘Exchange Rates and Jobs: What Do We Learn from Job Flows?’, *NBER macroeconomics annual*, 13, 153-208.

Greenan, N. and Guellec, D. (2000) ‘Technological Innovation and Employment Reallocation’, *Labour*, 14(4), 547-590.

Greene, W. (2003) *Econometric Analysis*, 5th Edition, Prentice Hall, New York.

Gronau, R. and Haim R. (1997) ‘The Demand for Labor and Job Turnover: Israeli Manufacturing 1970-1994’, *Working paper* No: 378 (industrial Relation Section, Princeton University.

Haas, M., Mittnik, S. and Paolella, M.S. (2004) ‘A New Approach to Markov-Switching GARCH Models’, *Journal of Financial Econometrics*, 2(4), 493-530.

Hall, R.E. (2005) ‘Employment Efficiency and Sticky Wages: Evidence from Flows in the Labor Market’, *Review of Economics and Statistics*, 87(3), 397-407.

Haltiwanger, J., Kugler, A., Kugler, M., Micco, A. and Pagés, C. (2004) ‘Effects of Tariffs and Real Exchange Rates on Job Reallocation: Evidence from Latin America’, *Journal of Policy Reform*, 7(4), 191-208.

Haltiwanger, J. and Vodopivec, M. (2002) ‘Gross Worker and Job Flows in a Transition Economy: An Analysis of Estonia’, *Labour Economics*, 9(5), 601-630.

Hamermesh, D.S., Wolter H, J.H. and Jan C.V. (1996) Job Turnover and Labour Turnover: A Taxonomy of Employment Dynamics’, *Annales d'Economie et de Statistique*, 41(1), 21-40.

Hamermesh, D.S. (2000) ‘The Craft of Labormetrics’, *Industrial and Labor Relations Review*, 53(3), 363-380.

Hamilton, J.D. (1989) ‘A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle’, *Econometrica*, 57(2), 357-384.

Hamilton, J.D. (1990) ‘Analysis of Time Series Subject to Change in Regime’, *Journal of Econometrics*, 45(1), 39-70.

Hamilton, J.D. (1994) *Time Series Analysis*, Princeton University Press, USA.

Hamilton, J.D. (1996) ‘This is What Happened to the Oil Price-Macroeconomy Relationship,’ *Journal of Monetary Economics*, 38(2), 215-220.

Hamilton, J.D. and Raj, B. (2002) ‘New Directions in Business Cycle Research and Financial Analysis’, *Empirical Economics*, 27(2), 149-162.

Hansen, B.E. (1992) ‘The Likelihood Ratio Test under Non-standard Conditions: Testing the Markov Switching Model of GNP’, *Journal of Applied Econometrics*, 7(2), 61-82.

Hansen, B.E. (1996) ‘Tests for Cointegration in Models with Regime and Trend Shifts’, *Oxford Bulletin of Economics and Statistics*, 58(3), 555-560.

Hansen, G.D., and Prescott, E.C. (2002) ‘Malthus to Solow’, *American Economic Review*, 92(4), 1205-1217.

Hassink, W. (2000) ‘Job Destruction through Quits or Layoffs?’, *Applied Economics Letters*, 7(1), 45-47.

Hassink, W. and Broersma, L. (2003) ‘Quits, Layoffs, and Job Destruction’, *Applied Economics*, 35(18), 1911-1914.

Hohti, S. (2000) ‘Job Flows and Job Quality by Establishment Size in the Finnish Manufacturing Sector 1980-94’, *Small Business Economics*, 15(4), 265-281.

Hotelling, H. (1933) ‘Review of The Triumph of Mediocrity in Business, by Horace Secrist’, *Journal of American Statistical* Association, 28(184), 463-465.

Hsu, S.H. and Kuan, C.M. (2001) ‘Identifying Taiwan’s business cycles in 1990s: An Application of the Bivariate Markov Switching Model and Gibbs sampling’, *Journal of Social Sciences and Philosophy*, 13(5), 515-540. (In Chinese)

Hsu, J.Y. and Cheng, L.L. (2002) ‘Revisiting Economic Development in Post-war Taiwan: The Dynamic Process of Geographical Industrialization’, *Regional Studies*, 36(8), 897-908.

Huang, C.H. (1999) ‘Phases and Characteristics of Taiwan Business Cycles: A Markov Switching Analysis’, *Taiwan Economic Review*, 27(2), 185-213.

Huang, H.C. and Lin, S.C. (2006) ‘Time-Varying Discrete Monetary Policy Reaction Functions’, *Applied Economics*, 38(4), 449-464.

Huang, Y.L., Kuan, C.M., and Lin, K.S. (1998) ‘Identifying the Turning Points of Business Cycles and Forecasting Real GNP Growth in Taiwan’, *Taiwan Economic Review*, 26(4), 431-457.

Hwa, E.C. (2000) ‘How Taiwan Weathered the Asian Financial Crisis’, *Review of Pacific Basin Financial Markets and Policies*, 3(4), 491-518.

Ilmakunnas, P. and Maliranta, M. (2003) ‘The Turnover of Jobs and Workers in a Deep Recession: Evidence from the Finnish Business Sector’, *International Journal of Manpower*, 24(3), 216-246.

International Institute for Management Development (IMD) (2003) *The World Competitiveness Yearbook*.

Isard, W. (1949) ‘Discussion of Interregional Variations in Economic Fluctuations’, *American Economic Review*, 39(1), 123-126.

Isard, W. (1957) *The Value of the Regional Approach in Economic Analysis in Regional Income: Studies in Income and Wealth.* Princeton University Press, USA.

Isard, W. (1960) *Methods of Regional Analysis*, Cambridge, MIT Press, Cambridge, Massachusetts, USA.

Jiang, F.F. and Liu, K.C. (2005) ‘A Panel Study of Regional Unemployment in Taiwan: 1987-2001’, *Journal of Population Study*, 31(1), 1-39. (In Chinese)

Jovanovic, B. (1982) ‘Selection and the Evolution of Industry’, *Econometrica*, 50(3), 649-670.

Juan, F., Rubio-Ramirez, D.W. and Tao, Z. (2005) Markov Switching Structural Vector Autoregressions: Theory and Application, *Working Paper* No: 27, Federal Reserve Bank of Atlanta, USA.

Juniper, J., Mitchell, W.F. and Myers, J. (2004) ‘Small Business Employment Dynamics in Australia’, *The Full Employment Imperative, Proceedings of the 6th Path to Full Employment Conference/11th National Conference on Unemployment,* University of Newcastle, December.

Kaminsky G. and Schmukler, S. (1998) ‘The Relationship between Interest Rates and Exchange Rates in Six Asian Countries’, *mimeo*, World Bank, Washington.

Kaufmann, S. (2002) ‘Is There an Asymmetric Effect of Monetary Policy over Time? A Bayesian Analysis Using Austrian Data’, *Empirical Economics*, 27(2), 277-297.

Keynes, J.M. (1964) *The General Theory of Employment, Interest and Money*, Harcourt Brace, London.

Kim, C.J. and Yoo, J.S. (1995) ‘New Index of Coincident Indicators: A Multivariate Markov switching Factor Model Approach’, *Journal of Monetary Economics*, 36(3), 607-630.

Kim, C.J. and Nelson, C.R. (1999) ‘Friedman's Plucking Model of Business Fluctuations: Tests and Estimates of Permanent and Transitory Components’, *Journal of Money, Credit, and Banking*, 31(3), 317-334.

Kim, C.J. and Murray, C.J. (2002) ‘Permanent and Transitory Components of Recessions’, *Empirical Economics,* 27(2), 163-183.

Kim, W. (2005) ‘Analyses of the Relationship between Exchange Rates and Employment in Korea’, *Journal of Economic Development*, 30(2), 131-153.

King**,** R.G. and Plosser, C.I. (2005) ‘The Econometrics of the New Keynesian Price Equation’, *Journal of Monetary Economics*, 52(6), 1059-1066.

Kirchhoff, B. and Greene, P. (1995) Response to the Renewed Attacks on the Small Business Job Creation Hypothesis, *Paper presented at the Babson College Entrepreneurship Research Conference*, London.

Kirchhoff, B. and Greene, P. (1998) ‘Understanding the Theoretical and Empirical Content of Critiques of U.S. Job Creation Research’, *Small Business Economics*, 10(2), 153-169.

Kirikos, D.G. (2000) ‘Forecasting Exchange Rates out of Sample: Random Walk vs Markov Switching Regimes’, *Applied Economics Letters*, 7(2), 133-136.

Klein, M.W., Schuh, S. and Triest, R.K. (2003) ‘Job Creation, Job Destruction, and the Real Exchange Rate’, *Journal of International Economics*, 59(2), 239-265.

Klette, T.J. and Mathiassen, A. (1996) ‘Job Creation, Job Destruction and Plant Turnover in Norwegian Manufacturing’, *Annales D’Economie et De Statistque*, 41-42(1), 97-125.

Koning, J. (1995) ‘Gross Job Flows and the Evolution of Size in U.K. Establishment’, *Small Business Economics*, 7(3), 213-220.

Koop, G., Pesaran, M.H. and Potter, S.M. (1996) ‘Impulse Response Analysis in Nonlinear Multivariate Models’, *Journal of Econometrics*, 74(1), 119-147.

Krolzig, H.M. (1997) *Markov Switching Vector Autoregression Modelling, Statistical Inference and Applications to Business Cycle Analysis*, Springer Press, Berlin.

Krolzig, H.M. and Toro, J. (1998) A New Approach to the Analysis of Shocks and the Cycle in a Model of Output and Employment, *Mimeo*, Department of Economics, European University Institute, Florence.

Krolzig, H.M. (2001) ‘Business Cycle Measurement in the Presence of Structural Change: International Evidence’, *International Journal Forecast*, 17(3), 349-368.

Krolzig, H.M., Marcellino, M., and Mizon, G.E., (2002) ‘A Markov-Switching Vector Equilibrium Correction Model of the UK Labour Market’, *Empirical Economics*, 27(2), 233-254.

Krugman, D. (1991) Did the Federal Reserve Cause the Recession?, *New York Times*, National Bureau of Economic Research (NBER), USA, April 1 1991.

Kuo S.D. (2005) *A Study on the Impacts of Development of Hualien Tourism and Leisure Industry on Eastern Regional Economy in Taiwan*, Doctoral dissertation, National Cheng Chung University, Taiwan. (In Chinese)

Lane, J., Stevens, D. and Burgess, S. (1996) 'Worker and Job Flows', *Economics Letters*, 51(1), 109-113.

Lee, J.C. (2004) The Structural Unemployment in Taiwan, *Mimeo*, National Policy Foundation (NPF), Taiwan

Leitemo, K. and Soderstrom, U. (2008) 'Robust Monetary Policy in the New Keynesian Framework', *Macroeconomic Dynamics*, 12(1), 126-135.

Leontaridi, M. (1998) 'Segmented Labour Markets: Theory and Evidence', *Journal of Economic Surveys*, 12(1), 63-101.

Lin, T.L., Chou, S.S., and Chen U.D. (2003) Small and Medium Enterprises Manpower Project, *China Times* (January 17).

Liu, D.C. (2005) Job creation and destruction by plant size in Taiwan, *Working Paper* 05-08, Centre of Full Employment and Equity, University of Newcastle, June.

Liu, D.C. (2005) Galton's Fallacy in Job creation and destruction, *18th Annual PhD Conference in Economics and Business*, University of Western Australia, November.

Lucas R.E. (1977) 'Understanding Business Cycles', *Studies in Business-Cycle Theory*, Blackwell Press, Oxford.

Maliar, L. and Maliar, S. (2004) ‘Endogenous Growth and Endogenous Business Cycles’, *Macroeconomic Dynamics*, 8(5), 559-581.

Masson, P. and Ruge-Murcia, F.J. (2005) ‘Explaining the Transition between Exchange Rate Regimes’, *Scandinavian Journal of Economics*, 107(2), 261-278.

Matouschek, N. Ramezzana, P. and Robert, N.F. (2008), Labor Market Reforms, Job Instability, and the Flexibility of the Employment Relationship, *CEP Discussion Paper* No: 865, Centre for Economic Performance, London.

Mariano, R.S., Gultekin, B.N., Ozmucur, S., Shabbir, T. and Alper, C.E. (2004) ‘Prediction of Currency Crises: Case of Turkey’, *Review of Middle East Economics and Finance*, 2(2), 87-107.

Martin, S. (2003) Shift-Share Analysis Helps Identify Local Growth Engines, *Mimeo*, The Pennsylvania State University, USA.

McLaughlin, G.E. (1930) ‘Industrial Diversification in American Cities’, *Quarterly Journal of Economics*, 45(1), 131-149.

McCallum, B.T. (1988) ‘Robustness Properties of a Rule for Monetary Policy’, *Carnegie-Rochester Conference Series on Public Policy*, 29 Autumn, 173-203.

McCallum, B.T. (1993) ‘Specification and Analysis of a Monetary Policy Rule for Japan’, *Monetary and Economic Studies*, 11(2), 1-45.

McQueen, G. and Thorley, S. (1993) ‘Asymmetric Business Cycle Turning Points’, *Journal of Monetary Economics*, 31(3), 341-362.

Mehta, C. R. and Patel, N.R. (1997) ‘Exact Inference in Categorical Data’, *Biometrics*, 53(1), 112-117.

Mitchell, W.F. (2001) The Unemployed Cannot Search for Jobs That Are Not There, in W.F. Mitchell and E. Carlson (2001), *Unemployment: the Tip of the Iceberg*, CAER/UNSW Press, Sydney, 85-117.

Mitchell, W.F. (2002) ‘Non-linearity in Unemployment and Demand Side Policy for Australia, Japan and the US’, *Working Paper 02-02*, *Centre of Full Employment and Equity*, The University of Newcastle, Australia.

Mitchell, W.F. and Muysken, J. (2003) ‘Employment Dynamics and Full-time Job Destruction in Australia’, *Working Paper* 03-02, Centre of Full Employment and Equity, University of Newcastle, Australia.

Mitchell, W.F., Myers, J. and Juniper, J. (2006) ‘The Dynamics of Job Creation and Destruction in Australia’, *Australian Journal of Social Issues*, Special Winter Edition, 247-259.

Mitchell, W.F. and Myers, J. (2007) ‘Are Gross Job Flows in Australia Sensitive to Exchange Rate Fluctuations?’, *International Journal of Environment, Workplace and Employment*, 3(3), 248-265.

Ministry of Economic Affairs (2007) *Statistics of Economic*, Taiwan.

Moreno, E. (2007) ‘Reorganization of Firms and Job Stability: A Theoretical Approach’, *Labour*, 21(3), 389-418.

Mortensen, D.T. (1994) ‘The Cyclical Behavior of Job and Worker Flows’, *Journal of Economic Dynamics and Control*, 18(6), 1121-1142.

Mortensen, D. and Pissarides, C. (1994) ‘Job Creation and Job Destruction in the Theory of Unemployment’, *Review of Economic Studies*, 61(3), 397-415.

Neumark, D., Wall, B. and Zhang, J. (2008) ‘Do Small Businesses Create More Jobs? New Evidence from the National Establishment Time Series’, *Working Paper* No: 13818, National Bureau of Economic Research (NBER), USA.

Organization for Economic Cooperation and Development (OECD) (1994) *SMEs: Employment, Innovation and Growth,* Paris.

Organization for Economic Cooperation and Development (OECD) (1996) *Job Creation and Loss: Analysis, Policy, and Data Development,* Paris.

Organization for Economic Cooperation and Development (OECD) (2004) *Small and Medium Enterprise in Turkey: Issues and Policies*, Paris.

Paap, R. and Dijk, V.H., (2003) ‘Bayes Estimates of Markov Trends in Possibly Cointegrated Series: An Application to US Consumption and Income’, *Journal of Business and Economics Statistics*, 21(4), 547-563.

Park, Y.C., Wang, Y. and Chung, C.S., (1999) ‘Exchange Rate Policies in Korea: Has Exchange Rate Volatility Increased after the Crisis? *EABER Working Paper* No: 367, Australian National University, Australia.

Persson, H. (1999) ‘Job Flows and Worker Flows in Sweden 1986-1995’, Ph.D. Thesis, Swedish Institute for Social Research (SOFI), Stockholm University, Stockholm.

Phelps, E.S. (1970) *Microeconomic Foundations of Employment and Inflation Theory,* Norton Press, New York.

Phillips, K. (1991) ‘A Two-Country Model of Stochastic Output with Changes in Regime’, *Journal of International Economics*, 31(1), 121-142.

Picot, G., Baldwin, J. and Dupuy, R. (1994) Have Small Firms Created a Disproportionate share of New Jobs in Canada: A Reassessment of the Facts. *A paper presented at the Canadian Economics Association Meeting*, June, Calgary, Alberta, Canada.

Pissarides, C.A. (1985) ‘Short-run Equilibrium Dynamics of Unemployment, Vacancies, and Real Wages’, *American Economic Review*, 75(3), 676-690.

Price, J.L. (1977) *The Study of Turnover*, Iowa State University Press, USA.

Quandt, R.E. (1972) ‘A New Approach to Estimating Switching Regressions’, *Journal of the American Statistical Association*, 67(338), 306-310.

Quah, D. (1993) ‘Galton’s Fallacy and Tests of the Convergence Hypothesis’, *The Scandinavian Journal of Economics*, 95(4), 427-443.

Ribeiro, E.P. (2004) ‘Trade Liberalization, the Exchange Rate and Job Flows in Brazil’, *Journal of Policy Reform*, 7(4), 209-223.

Rissman, E.R. (1999) ‘Regional Employment Growth and the Business Cycle’, *Economic Perspectives*, 23(4), 21-39.

Ritter, J.A. (1994) *Job Creation and Destruction: The Dominance of Manufacturing,* Federal Reserve Bank of St. Louis, September/October.

Roberts, M. (1996) *Industrial Evolution in Developing Countries: Micro Patterns of Reallocation, Productivity and Market Structure,* Oxford University Press, Oxford.

Schaller, H. and Norden, van S. (1997) ‘Regime Switching in Stock Market Returns’, *Applied Financial Economics*, 7(2), 177-191.

Schumpeter, J.A. (1942) *Capitalism, Socialism and Democracy,* Harper & Row Press, New York.

Secrist, H. (1933) The Triumph of Mediocrity in Business, *Mimeo,* Northwestern University, USA.

Selover, D.D. Jensen, R.V. and Kroll, J. (2005) ‘Mode-Locking and Regional Business Cycle Synchronization’, *Journal of Regional Science*, 45(4), 703-745.

Serrano, C.G. (1998) ‘Worker Turnover and Job Reallocation: The Role of Fixed-Term Contracts’, *Oxford Economic Papers*, 50(4), 709-725.

Shiau J.S. (2003) *The Causality in Cointegrated Processes: Evidences on Exchange Rate and Interest Rate*, Master Thesis, Tamkang University, Taiwan. (In Chinese)

Shimer, R. (2005) ‘The Cyclical Behavior of Equilibrium Unemployment and Vacancies’, *American Economic Review*, 95(1), 25-49.

Shu, Y. and Zeng, K. (2006) ‘FDI Flows between China and ASEAN: Emerging Factors and Prospect’, *China and World Economy*, 14(6), 98-106.

Sichel, D.E. (1993) ‘Business Cycle Asymmetry: A Deeper Look’, *Economic Inquiry*, 31(2), 224-236.

Sicherman, N. (1996) ‘Gender Differences in Departure from a Large Firm’, *Industrial and Labor Relations Review*, 49(3), 484-505.

Stiglbauer, A. (2003) ‘Job Creation and Job Destruction in a Regulated Labor Market: The Case of Austria’, *Empirica*, 30(2), 127-148.

Stigler, G.J. (1961) ‘The Economics of Information’, *Journal of Political Economy*, 69(3), 213-225.

Stigler, G.J. (1986) *The History of Statistics*, Harvard University Press, USA.

Still, K. (1997) Regional employment dynamics, *Working Paper* No: 97-28, Federal Reserve Bank of Philadelphia, USA.

Story, D. (1995) Job Creation in SMEs, *mimeo*, University of Warwick, UK.

Statistical Yearbook of Taiwan, (2002) The Directorate General of Budget, Accounting and Statistics (DGBAS) of Executive Yuan, Taiwan.

Statistical Yearbook of Taiwan, (2006) The Directorate General of Budget, Accounting and Statistics (DGBAS) of Executive Yuan, Taiwan.

Statistical Yearbook of Taiwan, (2007) The Directorate General of Budget, Accounting and Statistics (DGBAS) of Executive Yuan, Taiwan.

Smith, P. and Summer P. (2005) ‘How well do Markov switching models describe actual business cycles? The Case of Synchronization’, *Journal of Applied Econometrics*, 20(2), 253-274.

Svensson, L.E. (1998) ‘Inflation Targeting as a Monetary Policy Rule’, *Working Paper* No: 6790, National Bureau of Economic Research (NBER), USA.

Svensson, L.E. (2005) ‘Targeting versus Instrument Rules for Monetary Policy: What Is Wrong with McCallum and Nelson?’, *Federal Reserve Bank of St. Louis Review*, 87 (September), 613-625.

Small and Medium Enterprises Administration (SMEA) (2007) *SMEs White Paper,* Ministry of Economic Affairs, Taiwan.

Taiwan New Economy Newsletter (2002) Council for Economic Planning and Development, Taiwan.

Taiwan New Economy Newsletter (2006) Council for Economic Planning and Development, Taiwan.

Taylor, J. (1993) ‘Discretion versus Policy Rules in Practice’, *Carnegie–Rochester Conference Series on Public Policy*, 39 (December), 195-214.

Taylor, J. (1995) ‘The Monetary Transmission Mechanism: An Empirical Framework’, *Journal of Economic Perspectives*, 9(4), 11-26.

Tether, B.S. and Massini, S. (1998) ‘Employment Creation in Small Technological and Design Innovators in the U.K. during the 1980s’, *Small Business Economics*, 11(4), 353-370.

Thirlwall, A.P. (1969) ‘Weighting Systems and Regional Analysis: A Reply to Mr. Cunningham’, *Oxford Economic Papers*, 21(1), 128-133.

Tsai, Diana H.A. (2005) ‘Knowledge Spillovers and High-Technology Clustering: Evidence from Taiwan's Hsinchu Science-Based Industrial Park’, *Contemporary Economic Policy*, 23(1), 116-128.

Tsionas, E.G. and Kumbhakar, S.C. (2004) ‘Markov Switching Stochastic Frontier Model’, *Econometrics Journal*, 7(2), 398-425.

Tsou, M.W., Liu J.T. and Hammitt, J.K. (2001) ‘Worker Flows and Job Flows in Taiwan’, *Economics Letters*, 73(1), 89-96.

Tsou, M.W., Liu J.T., and Hammitt, J.K. (2002) ‘Workers Turnover and Job Reallocation in Taiwanese Manufacturing’, *Applied Economics*, 34(11), 401-411.

Tsou, M.W. and Liu J.T. (2005) ‘Wage Dispersion and Employment Turnover in Taiwan’, *Economics Letters*, 88(1), 408-414.

Vining, R. (1945) ‘Regional Variation in Cyclical Fluctuation View as a Frequency Distribution’, *Econometrica*, 13(3), 205-219.

Vining, R. (1946a) ‘Location of Industry and Regional Pattern of Business Cycle Behavior’, *Econometrica*, 14(1), 67-68.

Vining, R. (1946b) ‘The Region as a Concept in Business Cycle Analysis’, *Econometrica*, 14(3), 201-218.

Vining, R. (1949) ‘The Region as an Economic Entity and Certain Variations to be Observed in the Study of Systems of Regions’, *American Economic Review*, 39(1), 89-104.

Voulgaris, F., Papadogonas, T. and Agiomirgianakis, G. (2005) ‘Job Creation and Job Destruction in Greek Manufacturing’, *Review of Development Economics*, 9(2), 289-301.

Wagner, J. (1995) ‘Firm Size and Job Creation in Germany’, *Small Business Economics*, 7(6), 469-474.

Walsh, C. (2003) *Monetary Theory and Policy,* Second Edition, MIT Press, Cambridge, Massachusetts, USA.

Wen Y.K. (1997) Financial Liberalization and Capital Flows Mobility in Taiwan, *presented at the Western Economic Association International Annual Conference*, Seattle.

William, V.L. (2000) ‘A Review of the Rules versus Discretion Debate in Monetary Policy’, *Eastern Economic Journal*, 26(1), 29-39.

World Competitiveness Yearbook, (2003) International Institute for Management Development (IMD).

Woodford, M. (2003) *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press, Princeton.

Yang, C.H. and Lin, C.H. (2008) ‘Developing Employment Effects of Innovations: Microeconometric Evidence from Taiwan’, *Developing Economies*, 46(2), 109-134.

Yu, Y.S. (2003) ‘Can East Asia Rise Again?’, *Journal of Asian Economics*, 13(6), 715-729.

Yuan, J.C., Hsieh, C.H. and Wang, C. (2006) 'Foresight for the Semiconductor Industry in Taiwan', *Foresight*, 8(5), 45-55.