

THE IMPACT OF FUTURE OIL PRICE SHOCKS
ON THE CALIFORNIA ECONOMY

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Final Report

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Report prepared for the California Energy Commission
1516 Ninth Street, First Floor
Sacramento, CA 95814

Contract Manager: Cynthia R. Hobson

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Chapter

MACROECONOMIC IMPACTS

1.1 Introduction

Since the early Seventies every major economic downturn in the U.S. economy as well globally has been preceded by an oil price shock¹. Specifically, the interruption or the threat of interruptions of Persian Gulf oil in 1973-74 and 1979-80 caused widespread disturbances - inflation, unemployment, foregone production -- and the subsequent recovery process proved slow and painful².

California which is the second largest gasoline market in the world behind only the U.S., depends heavily on petroleum fuels to meet its transportation energy requirements. In 1992, transportation sector accounted for approximately 40 percent of all the energy consumed in the state. The total gasoline consumption of the state during the same period was close to 13 billion gallons.

¹ Historically prominent oil shocks are the OPEC oil price hike in 1973 and 1979 and the rise in oil prices following Iraq's invasion of Kuwait in 1990. Hamilton (1983, 1985) has done a rigorous statistical study detailing the causal effects of oil price shocks and recessions in the U.S. economy since the Korean war. Tatom (1990) provides an excellent exposition of the macroeconomic effects of an oil price shock in the face of changing nature of the U.S. economy. In particular whether the U.S. economy is less sensitive to oil shocks in the 90's or not.

² See the article by Llewellyn (1983) for a detailed description of the experience of the OECD countries. Sachs (1982) details the macroeconomic adjustment in the United States subsequent to the OPEC oil price shocks. The book by Fried and Trezise (1993) discusses in detail the likelihood of a future oil shock and its implications for the global economy as a whole.

With most of the world's oil resources being heavily concentrated in the politically fragile Middle East, oil supply interruptions and the resultant price hikes are a continuing possibility and a persistent concern to the policy makers both in the United States and California.

The purpose of this impact study is to evaluate the potential ramifications of a serious oil price hike on the California economy. This analysis takes a special significance in the face of the fact that California shifts to Phase 2 gasoline specifications in 1995⁴. A specific question that arises is whether the impact of an oil price shock will be more or less negative in its aggregative effects than it would be if the shift in gasoline specifications as required under Phase 2 had not been made.

This impact study answers both the general and the specific by making use of UCLA's business forecasting model for the U.S. and the California economy, and the information provided by the California Energy Commission (CEC). The first step in the simulation analysis was to make use of UCLA's business forecasting model for the overall U.S. economy (UCLA-BFUS) and study it for the different assumptions regarding the oil price shock. The next step was to feed the output from this model into the California model (UCLA-BFCA).

Tables 1 to 6 present, for selected variables, the base forecast in column 1, the simulation results under the alternative oil price assumptions in column 2, and the absolute and

³ The most recent example is the rise in crude oil prices following the invasion of Kuwait by Iraq in 1990.

⁴ The output from this study is designed to provide input to an ongoing analysis of the energy security implications of transportation policy alternatives. For a previous study of this kind see the report by Harrison and Kimbell (1981).

the relative difference between the base and the alternative forecast in columns 3 and 4 respectively. In all our simulations, the oil price shock is assumed to occur in the first quarter of year 2000 and the new price regime is in effect from that point onwards.

1.2 IMPACT PROJECTIONS

This subsection presents a Summary table of macroeconomic impacts for the oil price shock. Accompanying each table is a series of comments highlighting the more significant forecasts.

1.2. Regular Gasoline and oil price shock

Results for this simulation for the U.S. economy and California are presented in tables 1, 2 and 3. These tables correspond to forecast projections for year 2000, 2005 and 2010 respectively. Detailed results at the 2 digit SIC code level in the manufacturing sector for the California economy are presented later in chapter 3.

A 50% rise in the price of oil raises the price of crude oil to \$ 34.50 per barrel in the year 2000 and the gasoline price index rises to 205 in the same year⁵. In the absence of an oil price shock this price and the index are expected to be \$ 23.00 and 168

⁵ The magnitude of the crude price hike is based on the information contained in the CEC report on fuels (1994) and the California oxygenate outlook report (1993). The exact methodology is described in detail in the next chapter.

TABLE 1

SUMMARY OF IMPACTS OF A PURE OIL PRICE SHOCK IN YEAR 2000

		Shock	Diff	% Diff
Energy sector Impacts				
Gasoline Price Index	168	205	36	22.0
Crude price (\$/barrel)	23.00	34.50	.50	50.0
Gasoline & Oil Exp. (bil 87\$)	86.0	85.0	-1.0	16
U.S. economy Impacts				
Real GDP (bil 87\$)	6221.2	6199.2	-22.0	-0.35
Real GDP (%ch)	2.6	2.2	-0.4	-15.4
PPI (%ch)	3.6	8.4	5.2	153.0
CPI (%ch)	3.6	5.9	2.3	63.8
Employment (mil)	125.7	125.4	-0.3	-0.23
Unemployment rate (%)	6.	6.3	0.2	3.2
Car sales (mil)	.0	10.2	-0.8	-7.3
California Economy Impacts				
Real GSP bil 87\$)	756.4	752.0	-4.4	-0.58
Personal Income	618.3	609.9	-8.4	-1.36
Employment (nonag: mil)	13.74	13.65	-0.09	-0.66
Unemployment rate (%)	7.6	8.	0.5	6.57

respectively. Real consumer expenditures for gasoline and oil drops by more than 1% in the year 2000. In 2005 this decline is even larger -3.5%, and in the year 2010 the drop in the energy expenditure is still around 1%.

Real GDP is predicted to drop 0.35% as a result of the oil price hike in the year 2000.

The GDP decline is larger -- 0.83% in 2005 before becoming negligible in 2010.

TABLE 2

SUMMARY OF IMPACTS OF A PURE OIL PRICE SHOCK IN YEAR 2005

	Base	Shock	Diff	% Diff
Energy sector Impacts				
Gasoline Price Index	210	265	55.0	26.0
Crude price (\$/barrel)	29.39	44.09	14.7	50.0
Gasoline & Oil Exp. (bil 87\$)	87.0	84.0	-2.0	-2.3
U.S. economy Impacts				
Real GDP (bil 87\$)	7087.5	7029.2	-58.3	-0.83
Real GDP (%ch)	2.6	3.2	0.6	23.1
PPI (%ch)	3.4	3.2	-0.2	-5.8
CPI (%ch)	3.3	2.9	-0.4	-12.1
Employment (mil)	134.7	133.3	-1.3	-0.97
Unemployment rate (%)	5.8	6.7	0.9	15.5
Car sales (mil)	12.1	12.3	0.2	1.7
California Economy Impacts				
Real GSP (bil 87\$)	881.2	869.8	-11.4	-1.29
Personal Income	711.9	705.8	-6.1	-0.85
Employment (nonag: mil)	15.57	15.49	-0.08	-0.51
Unemployment rate (%)	7.1	7.3	0.2	2.81

The oil price shock forces the producers price index (PPI) to rise by 8.4% in year 2000 and the consumer price index (CPI) to rise by 5.8% in the same year. These levels fall back to the 3% range by the year 2005 and continue in the same range until the year 2010 too.

TABLE 3

SUMMARY OF IMPACTS OF A PURE OIL PRICE SHOCK IN YEAR 2010

	Base	Shock	Diff	% Diff
Energy sector Impacts				
Gasoline Price Index	262	330	68.0	26.0
Crude price (\$/barrel)	36.25	54.38	18.13	50.0
Gasoline & Oil Exp. (bil 87\$)	87.0	86.0	-2.0	-2.3
U.S. economy Impacts				
Real GDP (bil 87\$)	7953.	7952.4	-0.7	-0.01
Real GDP (%ch)	2.2	2.0	-0.2	-0.91
PPI (%ch)	3.4	3.7	0.3	8.8
CPI (%ch)	3.5	3.8	0.3	8.6
Employment (mil)	143.1	143.3	0.2	0.14
Unemployment rate (%)	5.7	5.6	-0.1	-1.8
Car sales (mil)	12.6	12.7	0.1	0.8
California Economy Impacts				
Real GSP (bil 87\$)	989.5	984.0	-4.5	-0.45
Personal Income	787.3	777.4	-9.9	-1.25
Employment (nonag: mil)	17.33	17.27	-0.06	-0.34
Unemployment rate (%)	5.8	5.9	0.1	.72

Car sales are affected, dropping by 7.4% immediately in the year 2000. This decline is reversed in the year 2005 when the car sales actually 1.7% above the base level. This phenomenon is observed in the year 2010 too.

Employment drops 0.3 million in the U.S. economy, raising the unemployment rate to 6.3% in the year 2000. This decline increases to 1.3 million jobs and a higher unemployment

rate of 6.7% which is almost a full percentage point above the base value for the year 2005. By year 2010, the U.S. economy has fully adjusted to the higher oil prices when the unemployment rate falls to 5.6% which is now even 0.1 percentage point below the base in the same year.

California real gross state product (GSP) is estimated to drop by 0.58% in the 2000. This is almost one and a half times the drop in the U.S GNP for the same year. decline in the California GSP is higher than the drop in the U.S. GNP in year 2005 too. the California GSP levels are below the base value even though the U.S. economy has fully recovered from the oil price impact in the year 2010

The decline in the personal income in California is larger than the decline in the GSP except in the year 2005.

Non-agricultural employment in California drops 0.09 million or by 90,000 in the year 2000. In percentage terms this decrease is larger than the percentage drop in the U.S. economy. But in the year 2005, the drop in employment is only 80,000 jobs or 0.51%. This percentage drop is one half of the drop in the U.S. economy as whole for the same year.

A similar phenomenon is present in California's unemployment rate changes when compared to the changes in the U.S. unemployment rate. Infact, in 2005 the unemployment rate in California rises by only 2.81% whereas the U.S. unemployment rate rises by 5.5%.

1.2.2 Oil shock and Phase 2 gasoline specifications

Tables 4, 5 and 6 present, for selected variables, the base forecast and the oil price shock simulations under the assumption that certain parts of U.S. and the entire state of

California have switched to Phase 2 of the reformulated gasoline specifications.

Under this scenario, the behavior of the U.S. economy is both qualitatively and quantitatively similar to the case of the an oil price shock for the regular gasoline case discussed in the subsection above. Hence, the tables focus on the effect of the oil price shock occurring in the first quarter of year 2000 for California only.

An additional consideration for concentrating on the California economy only is because the effect of the oil price shock is asymmetric in nature. This is due to the fact that the entire state of California adopts the Phase 2 gasoline specifications whereas only certain areas of the economy will be joining the Phase 2 gasoline specifications by the year 2000.

The results in Tables 4, 5 and 6 are qualitatively similar to that of the regular gasoline case in California. Charts 1 through 9 present the response of the California economy to the oil price shock in comparison to the behavior under the base assumptions and the fact that California has adopted reformulated gas.

Quantitatively there are a few minor differences when compared to the regular gasoline Charts 10 through 16 present the "net" difference between the responses

TABLE 4
SUMMARY OF IMPACTS OF A OIL PRICE SHOCK UNDER PHASE 2 GASOLINE SPECIFICATIONS FOR CALIFORNIA IN YEAR 2000

	Base	Shock	Diff	% Diff
California Economy Impacts				
Real GSP bil 87\$)	754.5	750.2	-4.3	-0.57
Personal Income	616.8	608.4	-8.4	-1.35
Employment (nonag: mil)	13.70	13.60	-0.10	-0.73
Unemployment rate (%)	7.7	8.2	0.5	6.49

TABLE 5
SUMMARY OF IMPACTS OF A OIL PRICE SHOCK UNDER PHASE 2 GASOLINE
SPECIFICATIONS FOR CALIFORNIA IN YEAR 2005

	Base	Shock	Diff	% Diff
California Economy Impacts				
Real GSP (bil 87\$)	879.1	867.8	-11.3	-1.29
Personal Income	710.2	704.2	-6.0	-0.84
Employment (nonag: mil)	15.53	15.45	-0.08	-0.52
Unemployment rate (%)	7.1	7.3	0.2	2.82

TABLE 6
SUMMARY OF IMPACTS OF A OIL PRICE SHOCK UNDER PHASE 2 GASOLINE
SPECIFICATIONS FOR CALIFORNIA IN YEAR 2010

	Base	Shock	Diff	% Diff
California Economy Impacts				
Real GSP (bil 87\$)	987.4	982.0	-5.4	-0.55
Personal Income	785.6	775.7	-9.9	-1.26
Employment (nonag: mil)	17.29	7.23	-0.06	-0.34
Unemployment rate (%)	5.8	5.8	0.0	0.00

to the oil price shock under the regular gasoline and the Phase 2 gasoline specifications. If this "net" difference is positive then the economy suffers less from the oil price shock under the Phase 2 gasoline specifications otherwise not.

In terms of GSP, personal income and sales, the effect of the oil shock is less negative for all the years till 2010. This implies no gains from switching to Phase 2 even in the long-

run. The relative gains are the highest in 2003, 3 years after the oil price hike.

Although, the gains in absolute terms in the GSP from Phase 2 gasoline specification are in the range of \$100 million in real terms, in percentage terms they are insignificant. is a very small gain when compared to the reduction in the GSP due to the implementation of the reformulated gas program which permanently reduces the GSP in California by approximately 2 billion dollars every year. However, these numbers do not account for the non-pecuniary gains resulting from a relatively cleaner environment because of use of reformulated gasoline.

In terms of employment and the unemployment rate, the effects of the oil price are relatively less negative immediately. Here too, the gains in employment are insignificant in percentage terms⁶. A more detailed sectoral analysis of employment changes is presented in Chapter 3.

⁶ A very likely conclusion is that the less negative effect of the oil shock under Phase 2 is due to pure noise.

Chapter 2

METHODOLOGICAL ISSUES

This study provides an assessment of the impact of oil price and/or gasoline price hike on the California economy. The analytical technique chosen is designed to meet a number of objectives:

- (a) a need for quantitative measures of the various impacts;
- (b) consideration of short-term macroeconomic responses;
- (c) explicit recognition of the interdependence of the California economic activity with the rest of the U.S. economy and the world;
- (d) Analyzing the role played by Phase 2 gasoline specifications in weathering a oil price shock by the California economy.

Given that no single analytical model can satisfactorily meet all these objectives, our general methodology was to use the existing modelling techniques and make adjustments to them to examine the relevant issues. The remainder of this chapter describes our research design and our adjustments to the modelling techniques to analyze the impact of energy shortfall on a regional economy. Specifically, two models were employed -- macro-econometric model of the U.S. and California economy. These models form the core of our quantitative projections. Chapter 3 provides several concluding perspectives on the two models adopted. Finally, a series of Appendices provides the technical details about the important features of the various models.

2.1 DIMENSIONS OF THE IMPACT ANALYSIS

We are concerned with the impact of an oil price shock and not the potential cause of it. Thus, the measures of impact adopted refer to both the level and incidence of the changes in U.S. and California economic activity resulting from the price hike. More specifically, the results include measures of:

- (a) gross state product and its components in current and constant dollars;
- (b) personal state income;
- (b) indices of industrial production at the two-digit SIC code industry detail;
- (c) state level unemployment changes;
- (d) indices of prices and wages;
- (f) interest rates;
- (g) residential and nonresidential investment

All these features are generated by the UCLA-BFCA model after constructing a suitable bridge from a macro-model of the U.S. economy to the California model. This is achieved by taking into account the information provided by CEC and the output of the Department of Energy's (DOE's) Alternative Fuels Trade Model (AFTM). The shock to the oil price is to begin in the first quarter of year 2000, a period after which the Phase 2 gasoline specifications are fully into the market stage. Impacts are generated for years 2001, 2002, 2003, 2004, 2005 and 2010, providing an impact horizon of between one and ten years.

2.2 METHODOLOGY

We start with a set of assumptions regarding the performance of the U.S. economy for the next fifteen years. This includes among others, assumptions regarding the behavior of the future U.S. fiscal and monetary policies, conditions in the Rest of the World (ROW), behavior of exchange rates and the demographic changes. These are referred to as the baseline assumptions and give rise to our base forecast for the U.S. and through the use of the UCLA-BFCA model a base forecast for California too. All the subsequent analysis is conditional on these assumptions. In addition, this baseline economy (BASE) is modified to analyze the impact of Phase 2 gasoline specifications (BASE2).

Next step is to shock the baseline economy for U.S. by an oil price shock. This provides us with the oil shock adjusted forecast for U.S. (USOIL) and California (CAOIL). Another set of simulations is performed by shocking the modified U.S. economy (for Phase 2 assumptions) by an oil price rise. This gives rise to Phase 2 adjusted, oil shocked forecast for U.S. (USOIL2) and California (CAOIL2). The present study is concerned with the differences between the oil shocked forecast which serves as the starting point and the Phase 2 modified oil shocked forecast for the relevant entities.

The above procedure makes our results about the impact of an oil price shock dependent upon the baseline assumptions to a certain extent. Here, the absolute magnitudes of certain economic variables, such as reported in the columns 1 and 2 in the tables of chapter ., are likely to change as our assumptions about the overall economy change. On the other hand, these assumptions are maintained for both the base (modified base too) and the oil price shock simulations. They therefore have relatively little influence on the "net" results that are the

focus of this study.

An additional concern is the impact of an oil price shock when the overall economy is booming as compared to during a recessionary state, or when the government is choosing to cut federal deficits by more or less of what is expected, or if the Federal Reserve system is following a "loose" or a "tight" monetary policy. These concerns are embodied in our baseline forecasts which reflects our best guesses about them. Again these are not expected to affect our "net" results.

2.3 ASSUMPTIONS SPECIFIC TO THE BEHAVIOR OF OIL PRICE

To analyze the effect of an oil price shock we used the information regarding the price of crude oil in the international market and the price of the imported crude oil both before and after the shock⁷. The baseline price of a barrel of OPEC crude in the international market is taken to be \$24.196. Note that this price and all the subsequent price calculations are in 1991 prices. After an oil shock this price is expected to rise to \$38.011 -- an increase of 57%. The corresponding reduction in the quantity of fuel imports is 23.5% and the quantity weighted change in the price of the imported oil is 42%.

Assuming that the domestic price of crude oil is at par with the international price and the share of imports in the total consumption which historically has been around 40%, produces a 50% increase in the price of a barrel of oil⁸.

⁷ These figures have been provided to us by the California Energy Commission.

⁸ This price increase takes into account the substitution of non-oil sources of energy for oil and it's dampening effect on the crude oil prices.

Next, is the calculation of the price of gasoline before and after the shock to the price of crude oil. Prior to the oil shock, the price for a gallon of gasoline is \$1.216. After the shock it is expected to rise to \$1.528 per gallon -- an increase of 25.7%. This raises the question about what would be the price of a gallon of gasoline if Phase 2 gasoline specifications are in effect.

According to the CEC's calculations, the cost of oxygenating the gasoline will be 15.9 cents in the year 2000. This implies that the cost of reformulated gasoline prior to an oil price shock will be \$1.3756 in California and other places which are allowed to adopt Phase 2 gasoline specifications. The rest of the U.S. will continue to use the normal gasoline. Assuming that the opt-in areas join Phase 2 in a planned manner, and given that they account for 53.7% of total U.S. gasoline consumption, their share of reformulated gasoline consumption is estimated to be 27.9% of the total U.S. gasoline consumption⁹. Given that the rest of the consumption (71.9%) is the regular gasoline, this produced a quantity weighted price of \$1.262 for gasoline in the U.S. economy, which represents a rise of only 3.8% for the U.S. economy compared to the 13% rise in California gas prices under Phase 2.

In response to an oil price shock, the price of normal gasoline increases to \$1.528 per gallon. This represents an increase of 25.7% in the price of gas. For areas that use the reformulated gas the price increase is calculated in the following manner.

Subsequent to an oil price hike the price of alternate fuels such as methanol will also

⁹ This figure is arrived at by calculating the gasoline consumption figures for the planned opt-in case as a percentage of a 100% opt-in case and multiplying by 0.537. This gives us the share of reformulated gasoline in the total gas consumption including spillage. This figure is based on the numbers reported in the California Oxygenate Outlook (1993).

go up. As methanol is used to produce the MTBE's required for oxygenating the gasoline, the price of oxygenating the gas would also increase. We assume that the price of oxygenation rises by less than the percentage change in the price of normal gas. For our calculations it is assumed to increase by one half the increase in price of normal gas or by 12.8%. This makes the new price of the reformulated gas to be \$1.707 in California-- a final increase of 24.05 percent.

Assuming that the consumption patterns do not change in the short-run, the quantity weighted average price of the new gas is \$1.578 for the U.S. economy after the oil shock in the reformulated gas case. When compared to the regular gasoline case oil price shock scenario where the price of gasoline is \$1.528, this is only a 3.3% increase for the U.S. but a 11.7% rise in California. Table 7 summarizes these and some other calculations.

Table 7 Projected Price of Gasoline in U.S. and California

Price per Gallon	Base Case (a)	Oil Shock (b)	Phase 2 Price (c)	Phase 2 & Oil Shock (d)
U.S.	1.216	1.528	1.262	1.578
California	.216	1.528	.376	1.707
% change in Price		(b)-(a)	(c)-(a)	(d)-(c)
U.S.		25.7	3.8	25.0
California		25.7	13.1	24.05

CHAPTER 3

CALIFORNIA EMPLOYMENT IMPACTS

3.1 OIL SHOCK AND PHASE 2 GASOLINE SPECIFICATIONS

In this chapter we present the projections for California that are generated by the macro-model for California (UCLA-BFCA). Specifically, the emphasis is on the employment changes at the 2 digit SIC codes. The impact projections are derived from the macro projections for the U.S. economy as a whole by using the bridge model developed by the UCLA forecasting group.

Table 8 presents the employment at the two digit level for the years 1995 to 2010 for the base case and the assumption that the entire state of California is under Phase 2 of gasoline specifications. Table 9 presents the employment figures for the same time period but after an oil price shock in the first quarter of year 2000. Table 10 presents the employment differences in thousands before and after the shock. Charts 17 to 27 present the behavior of employment for selected industries.

Of the 93,000 jobs lost by California in the year 2000 following the oil price shock, 59,000 are lost in the services sector and 15,000 in the finance sector. The manufacturing sector suffers from the oil price shock with a one year delay and suffers the most in the year 2003. By 2007, however, it posts a modest gain in jobs.

The services sector bears the brunt of the job losses and these losses are there for the entire period. The same is true for the finance sector. But the trade

Table 8. CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS -- BASE CASE

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
NONFARM	12144	12497	12798	13100	13394	13699	14029	14400	14798	15157	15530	15920	16284	16628	16956	17292
Mining	31	30	29	29	29	29	28	27	27	26	26	26	27	27	27	26
Construction	470	501	526	534	537	538	535	534	536	537	539	545	549	550	549	546
Manufacturing	1721	1702	1699	1714	1725	1741	1756	1768	1786	1796	1810	1830	1851	1867	1877	1883
Nondurable Goods	699	706	712	724	732	742	751	759	770	778	785	794	804	812	818	823
Food and Kindr Fd.	182	183	183	186	188	189	191	192	194	195	196	196	197	198	199	200
Textile Mill Prod.	17	17	17	17	17	18	19	19	20	20	21	21	21	21	22	22
Apparel	142	146	149	151	150	150	148	146	145	145	146	147	147	148	147	146
Paper	39	40	40	40	41	41	41	41	41	41	41	42	42	42	42	42
Print.Publish.	153	154	155	159	162	165	169	172	177	180	183	187	191	194	196	198
Chemicals & Allied	71	72	72	73	75	78	81	84	87	89	91	92	94	95	97	99
Petroleum & Coal	21	20	20	20	20	19	19	18	18	18	18	18	18	18	17	17
Rubber & Misl.	69	70	71	73	74	77	79	81	83	84	86	87	89	91	92	93
Leather	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Durable Goods	1022	996	987	990	994	999	1005	1009	1016	1018	1025	1036	1047	1056	1059	1060
Lumber & Wood	45	49	56	61	62	62	61	61	59	59	59	58	58	57	57	56
Furniture & Fixt.	47	48	51	53	53	54	56	57	58	59	59	60	61	62	63	64
Stone, Clay & Gls.	48	50	53	55	55	55	54	54	54	54	54	54	54	54	53	53
Primary Metal		31	30	30	30	31	32	33	34	34	34	34	35	35	36	36
Fabricated Metal		101	98	95	92	90	88	86	84	83	83	84	84	83	82	81
Machinery		177	173	168	164	162	160	158	157	156	157	159	161	161	161	159
Computers		83	81	79	77	77	77	77	77	78	79	81	83	84	84	84
Other Machinery		94	91	89	87	85	84	82	80	79	78	78	78	77	77	75

Table 8. CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS -- BASE CASE : CONTINUED

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Electric & Electronic	205	203	205	213	224	234	241	246	252	256	259	264	268	273	277	281
Communications Equip.	31	32	32	31	31	30	30	31	31	32	32	32	33	33	33	34
Electronic Components	115	114	114	116	121	125	128	129	131	132	134	136	138	140	141	142
Other Electronic&Ele	59	58	59	66	73	79	83	86	90	92	94	95	98	100	102	105
Transportation Equipt.	162	148	138	130	124	121	119	119	119	119	121	122	124	124	124	123
Aircraft & Parts	83	72	63	56	51	48	47	47	47	48	49	50	52	52	52	51
Missiles & Space	35	33	32	33	33	33	34	34	34	35	35	35	35	35	35	35
Other Transp.Equip	44	42	42	41	40	39	39	38	37	37	37	37	37	37	37	36
Instruments & Rel.Prod	163	153	150	151	153	155	157	159	162	162	160	162	165	168	169	169
Aerospace Instrum.	59	51	47	45	43	41	39	37	35	31	27	25	25	24	22	20
Measuring & Contrl.	53	52	51	53	54	56	58	60	62	64	66	68	70	72	74	75
Other Instrum.	51	51	52	54	55	58	60	62	65	66	67	69	70	71	73	74
Trans., Public Util.	601	607	614	625	636	650	664	678	692	703	714	724	734	745	756	769
Trade	2820	2923	3028	3117	3195	3276	3370	3480	3594	3700	3816	3938	4047	4150	4253	4359
Wholesale	677	690	713	736	759	781	811	848	889	923	958	994	1030	1065	1100	1137
Retail	2143	2232	2315	2381	2437	2494	2559	2632	2705	2777	2858	2944	3018	3086	3153	3222
Finance, Ins., R.E.	797	832	850	860	872	889	910	935	957	983	1006	1027	1045	1063	1081	1103
Finance	379	393	395	389	388	391	395	398	399	404	407	409	409	408	406	404
Insurance	220	227	232	238	243	251	261	270	278	286	294	301	308	315	323	332
Real Estate	199	213	223	233	241	246	255	267	279	293	305	317	328	339	352	367
Services	3597	3737	3838	3954	4074	4199	4330	4476	4629	4768	4906	5050	5187	5321	5448	5585
Hotels	184	192	197	201	206	212	220	227	234	241	247	252	258	264	270	277
Personal Services	117	123	126	128	130	133	137	140	143	146	148	151	154	156	159	162

Table 8. CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS -- BASE CASE : CONTINUED

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Business Services	805	847	887	928	969	1011	1057	1106	1159	1210	1263	1318	1373	1427	1481	1536
Auto Repair	181	189	195	201	208	218	230	242	254	265	275	285	295	305	315	327
Motion Pictures	132	139	146	154	164	174	184	196	209	219	226	232	239	247	256	265
Amusements	175	183	189	197	204	210	215	221	228	235	242	248	255	261	267	275
Health Services	844	881	911	940	969	996	1024	1056	1091	1121	1156	1192	1224	1251	1272	1295
Professional Services	387	404	417	433	451	467	484	502	521	539	558	580	600	620	638	656
Other Services	770	778	771	771	773	777	780	785	791	793	792	791	790	790	790	792
Government	2108	2165	2213	2268	2326	2378	2435	2502	2577	2643	2713	2781	2843	2905	2965	3021
Federal	324	319	318	320	322	325	328	329	333	334	335	337	338	340	342	345
State and Local	1784	1846	1895	1948	2005	2054	2107	2173	2245	2309	2377	2444	2505	2564	2623	2677
FARM	365	363	364	365	367	369	370	370	371	373	373	374	374	375	374	374
Household Survey (Thousand)																
Total Employment	14414	14780	15050	15326	15597	15871	16200	16573	16974	7336	17712	18105	18471	18817	19148	19485
Unemployed	1275	1130	1141	1175	1235	1319	1371	1385	1368	1379	1358	1306	1268	1241	1226	1205
Labor Force	15689	15910	16191	16501	16833	17189	17570	17958	18342	8715	19070	19410	19738	20058	20373	20690
Unemployment Rate (%)	8.1	7.1	7.0	7.1	7.3	7.7	7.8	7.7	7.5	4	7.1	6.7	6.4	6.2	6.0	5.8

Table 9. CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS -- OIL SHOCK CASE

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
NONFARM	12143	12497	12797	13100	13394	13607	13942	14320	14699	15059	15457	15849	16200	16535	16869	17231
Mining	31	30	29	29	29	29	28	27	26	25	26	26	27	27	27	27
Construction	470	501	526	534	537	536	530	532	532	525	522	521	522	528	537	547
Manufacturing	1721	1702	1699	1714	1725	1737	1735	1733	1742	1758	1788	1824	1858	1880	1887	1887
Nondurable Goods	699	706	712	724	732	743	749	752	760	769	782	797	811	821	827	830
Food and Kindr Fd.	182	183	183	186	188	189	191	193	194	196	197	198	199	200	201	201
Textile Mill Prod.	17	17	17	17	17	18	18	19	20	20	21	21	21	22	22	22
Apparel	142	146	149	151	150	149	146	143	141	142	144	146	148	149	148	146
Paper	39	40	40	40	41	41	41	41	41	41	41	42	42	42	42	42
Print. Publish.	153	154	155	159	162	165	167	167	170	173	179	186	192	196	198	199
Chemicals & Allied	71	72	72	73	75	78	81	84	86	88	90	92	94	96	97	99
Petroleum & Coal	21	20	20	20	20	22	21	21	21	21	21	21	21	21	21	21
Rubber & Miscl.	69	70	71	73	74	76	78	79	81	83	85	87	89	91	92	93
Leather	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Durable Goods	1022	996	987	990	994	993	986	981	983	989	1005	1027	1047	1059	1061	1057
Lumber & Wood	45	49	56	61	62	62	61	60	59	58	58	58	58	57	57	56
Furniture & Fixt.	47	48	51	53	53	54	55	56	57	58	59	60	61	62	63	64
Stone, Clay & Gls.	48	50	53	55	55	55	54	54	54	54	54	54	54	54	53	53
Primary Metal	31	31	30	30	30	31	32	33	33	34	34	34	35	35	36	36
Fabricated Metal	105	101	98	95	92	90	87	84	82	81	82	83	84	84	83	81
Machinery	181	177	173	168	164	161	158	153	150	150	154	158	162	163	162	160
Computers	84	83	81	79	77	76	75	73	72	73	76	80	84	86	86	84
Other Machinery	97	94	91	89	87	85	83	80	78	77	78	78	78	78	77	75

Table 9. CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS -- OIL SHOCK CASE: CONTINUED

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Electric & Electronic	205	203	205	213	224	233	240	243	248	252	257	262	268	273	277	280
Communications Equip.	31	32	32	31	31	30	30	31	31	31	32	32	32	32	33	33
Electronic Components	115	114	114	116	121	125	127	127	128	129	132	135	138	141	142	143
Other Electronic&Ele	59	58	59	66	73	79	83	85	89	91	93	95	98	100	102	105
Transportation Equipmt.	162	148	138	130	124	120	116	113	111	112	116	119	122	123	122	120
Aircraft & Parts	83	72	63	56	51	48	46	44	42	44	47	50	52	53	53	51
Missiles & Space	35	33	32	33	33	33	32	32	32	32	32	33	33	33	33	33
Other Transp.Equip	44	42	42	41	40	39	38	37	37	36	37	37	37	37	37	36
Instruments & Rel.Prod	163	153	150	151	153	152	147	148	153	154	156	160	165	167	168	167
Aerospace Instrum.	59	51	47	45	43	39	30	29	30	28	25	24	23	22	20	18
Measuring & Contrl.	53	52	51	53	54	56	57	57	58	60	64	68	71	74	75	75
Other Instrum.	51	51	52	54	55	58	60	62	64	66	67	68	70	72	73	75
Trans., Public Util.	601	607	614	625	636	646	661	675	688	700	711	721	732	742	753	765
Trade	2820	2923	3028	3117	3195	3283	3401	3517	3627	3731	3845	3965	4074	4180	4289	4400
Wholesale	677	690	713	736	759	783	818	857	896	928	963	1000	1036	1072	1110	1148
Retail	2143	2232	2315	2381	2437	2500	2583	2661	2732	2802	2882	2965	3038	3108	3179	3253
Finance, Ins., R.E.	797	832	850	860	872	874	896	922	941	967	992	1012	1029	1046	1064	1090
Finance	379	393	395	389	388	384	389	393	392	396	399	400	400	399	399	400
Insurance	220	227	232	238	243	248	258	267	275	284	292	299	306	313	320	329
Real Estate	199	213	223	233	241	241	250	262	274	288	302	313	323	334	346	361
Services	3596	3737	3838	3954	4074	4139	4273	4424	4572	4715	4867	5012	5139	5259	5380	5523
Hotels	184	192	197	201	206	210	217	225	232	238	245	251	256	262	268	275
Personal Services	117	123	126	128	130	132	136	139	142	145	148	150	153	155	158	161

Table CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS -- OIL SHOCK CASE: CONTINUED

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Business Services	805	847	887	928	969	1004	1050	1100	1151	1202	1257	1313	1366	1419	1473	1530
Auto Repair	181	189	195	201	208	214	226	238	250	262	273	282	291	300	310	323
Motion Pictures	132	139	146	154	164	172	183	195	207	217	225	231	238	246	254	264
Amusements	175	183	189	197	204	207	212	219	225	233	240	247	252	258	264	271
Health Services	844	881	911	940	969	982	1010	1043	1077	1109	1146	1183	1212	1237	1256	1280
Professional Services	387	404	417	433	451	459	476	495	514	532	553	575	594	611	628	647
Other Services	770	778	771	771	773	760	764	771	775	778	781	780	776	772	770	773
Government	2107	2165	2213	2268	2326	2363	2418	2491	2570	2637	2706	2768	2820	2873	2931	2990
Federal	324	319	318	320	322	325	328	329	333	334	335	337	338	340	342	345
State and Local	1783	1846	1895	1948	2005	2038	2090	2161	2237	2303	2371	2431	2482	2533	2589	2646
FARM	365	363	364	365	367	369	370	370	370	371	373	374	375	375	375	374
Household Survey (Thousand)																
Total Employment	14413	14780	15050	15326	15597	15779	1	3	16493	16874	17237	17638	18034	18388	18725	19424
Unemployed	1276	1130	1141	1175	1235	1408		6	1444	1439	1442	1389	1326	1295	1273	1202
Labor Force	15689	15910	16191	16501	16833	17186	1	9	17938	18313	18679	19027	19360	19683	19998	20626
Unemployment Rate (%)	8.1	7.1	7.0	7.1	7.3	8.2		2	8.1	7.9	7.7	7.3	6.8	6.6	6.4	5.8

Table 10. CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS MINUS OIL SHOCK LESS BASE

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
NONFARM	-1	-0	-0	-0	0	-93	-87	-80	-99	-98	-73	-71	-83	-92	-87	-61
Mining	-0	-0	-0	-0	0	0	0	-0	-1	-1	-1	-0	0	1	1	1
Construction	-0	-0	-0	-0	-0	-2	-5	-2	-5	-11	-17	-23	-27	-22	-12	1
Manufacturing	-0	-0	-0	0	0	-4	-21	-35	-44	-38	-23	-6	7	12	10	4
Nondurable Goods	-0	-0	-0	0	0	2	-2	-7	-11	-9	-3	3	7	9	9	7
Food and Kindr Fd.	-0	-0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
Textile Mill Prod.	-0	-0	0	0	0	0	-0	-0	-0	-0	0	0	0	0	0	0
Apparel	-0	-0	-0	0	0	-0	-1	-3	-4	-3	-2	-0	1	1	1	0
Paper	-0	-0	-0	0	0	-0	-0	-0	-0	-0	-0	-0	0	0	0	0
Print.Publish.	-0	-0	-0	0	0	-1	-2	-5	-7	-6	-4	-1	1	2	2	1
Chemicals & Allied	-0	-0	-0	0	0	-0	-0	-1	-1	-1	-1	-0	0	0	0	0
Petroleum & Coal	0	0	0	0	0	2	3	3	3	3	3	3	4	4	4	4
Rubber & Miscl.	-0	-0	-0	0	0	-0	-1	-1	-2	-2	-1	-0	0	1	0	0
Leather	0	0	0	-0	-0	-0	-0	0	0	0	0	-0	-0	-0	-0	-0
Durable Goods	-0	-0	-0	0	0	-6	-19	-28	-33	-30	-19	-9	-1	3	1	-3
Lumber & Wood	-0	-0	0	0	0	0	-0	-0	-1	-0	-0	-0	-0	0	0	0
Furniture & Fixt.	-0	0	0	0	0	-0	-0	-1	-1	-1	-1	-0	0	0	0	0
Stone,Clay & Gls.	-0	-0	-0	0	0	0	-0	-0	-0	-0	-0	-0	-0	0	0	0
Primary Metal	0	0	0	0	0	0	0	-0	-0	-0	-0	-0	-0	0	0	0
Fabricated Metal	-0	-0	-0	0	0	-0	-1	-2	-3	-2	-1	-0	0	1	1	0
Machinery	-0	-0	-0	0	0	-1	-2	-5	-7	-6	-4	-1	1	2	2	1
Computers	-0	-0	-0	0	0	-0	-2	-4	-6	-5	-3	-1	1	2	1	1
Other Machinery	-0	-0	-0	0	0	-0	-0	-1	-1	-1	-1	-0	0	0	0	0

Table 10. CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS -- OIL SHOCK LESS BASE: CONTINUED

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Electric & Electronic	-0	-0	-0	0	0	-1	-2	-3	-4	-4	-3	-1	-0	1	0	-0
Communications Equip.	-0	-0	-0	-0	-0	-1	-0	0	0	-0	-0	-1	-1	-1	-1	-1
Electronic Components	-0	-0	-0	0	0	-0	-1	-3	-4	-3	-2	-1	1	1	1	0
Other Electronic&Ele	-0	-0	-0	0	0	-0	-0	-1	-1	-1	-1	-0	0	0	0	0
Transportation Equipt.	-0	-0	-0	0	0	-1	-3	-6	-7	-7	-5	-3	-2	-1	-1	-2
Aircraft & Parts	-0	-0	-0	0	0	0	-1	-3	-4	-4	-2	-1	1	1	1	0
Missiles & Space	-0	-0	-0	0	0	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-3
Other Transp.Equip	-0	-0	-0	0	0	-0	-0	-0	-1	-1	-0	-0	0	0	0	0
Instruments & Rel.Prod	-0	-0	-0	0	0	-3	-10	-11	-9	-8	-5	-2	-1	-0	-1	-2
Aerospace Instrum.	-0	-0	-0	0	0	-3	-9	-7	-4	-3	-2	-2	-1	-2	-2	-3
Measuring & Contrl.	-0	-0	-0	0	0	-0	-1	-3	-4	-4	-2	-1	1	1	1	0
Other Instrum.	-0	-0	-0	0	0	-0	-0	-1	-1	-1	-0	-0	0	0	0	0
Trans., Public Util.	-0	-0	-0	0	0	-4	-4	-3	-4	-4	-3	-2	-3	-3	-3	-3
Trade	-0	0	-0	-0	-0	7	31	37	34	31	29	27	27	30	35	42
Wholesale	-0	0	-0	-0	-0	2	7	8	7	5	5	5	6	8	9	11
Retail	-0	0	-0	-0	-0	6	24	29	27	25	24	22	21	22	26	31
Finance, Ins., R.E.	-0	-0	-0	-0	0	-15	-14	-13	-16	-16	-14	-14	-16	-17	-16	-13
Finance	-0	-0	-0	-0	-0	-7	-6	-6	-7	-8	-8	-9	-10	-9	-7	-4
Insurance	-0	-0	-0	-0	0	-3	-3	-3	-3	-3	-2	-2	-2	-3	-3	-3
Real Estate	-0	-0	0	0	0	-5	-5	-5	-6	-5	-4	-3	-4	-6	-6	-6
Services	-0	-0	-0	-0	0	-59	-57	-52	-57	-53	-39	-38	-49	-61	-68	-62
Hotels	-0	-0	-0	-0	0	-3	-2	-2	-2	-2	-2	-2	-2	-2	-3	-2
Personal Services	0	0				-1	-1	-1	-1	-1		-1				

Table 10. CALIFORNIA EMPLOYMENT LEVELS IN THOUSAND'S (PAYROLL SURVEY) -- REFORMULATED GAS -- OIL SHOCK LESS BASE: CONTINUED

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Business Services	-0	0	0	-0	0	-7	-7	-6	-8	8	-6	-6	-7	-8	-8	-5
Auto Repair	-0	-0	-0	-0	0	-4	-4	-4	-4	-4	-3	-3	-3	-4	-5	-5
Motion Pictures	-0	-0	-0	-0	0	-2	-2	-2	-2	-2	-1	-1	-1	-2	-2	-2
Amusements	-0	-0	-0	-0	0	-3	-3	-3	-3	-3	-2	-2	-3	-3	-4	-3
Health Services	-0	-0	-0	-0	0	-15	-14	-13	-14	-13	-9	-9	-12	-15	-16	15
Professional Services	-0	-0	-0	-0	0	-8	-8	-7	-8	-7	-5	-5	-6	-8	-9	-9
Other Services	-0	-0	-0	-0	0	-17	-17	-15	-16	-15	11	-11	-14	-18	-20	19
Government	-0	-0	0	0	0	-15	-17	-11	-8	-6	-7	-13	-23	-31	-34	
Federal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
State and Local	-0	-0	0	0	0	-15	-17	-11	-8	-6	-7	-13	-23	-31	-34	
FARM	-0	0	-0	0	0	1	0	-1	-1	-1	-1	0	0	1	0	
Household Survey (Thousand)																
Total Employment	-1	-0		-0	0	-92	-87	-80	-100	-99	-74	-71	-83	-92	-87	
Unemployed	1	0		0	-0	89	75	60	72	63	31	20	28	32	25	
Labor Force	0	0		-0	-0	-3	-12	-20	-29	-36	-43	-50	-55	-59	-62	
Unemployment Rate (%)	0.0	0.0		0.0	0.0	0.5	0.4	0.3	0.4	0.4	0.2	0.1	0.2	0.2		

sector is the one that gains not only in the year of the shock but also in every year after the oil shock. Although, these gains offset the loss of jobs in the services sector they cannot fully overcome the total decline.

Given that the firms in the trade sector are typically smaller in size, gains in retail and wholesale trade are a continuation of the U.S. economy wide trend of growth in small and medium sized firms since early 80's [Brock and Evans (1989)]. As the oil shock makes people commute less and shop closer to home, it boosts the employment in the trade sector. On the other hand services is also dominated by small firms but still suffers as the demand for services is dependent upon disposable income which drops following an oil shock. The recovery of the manufacturing sector is linked to the recovery in the overall U.S. economy which serves as an export recipient for California products.

3.2 IS THE SHOCK MORE OR LESS NEGATIVE UNDER PHASE 2 ?

The above question can only be answered by looking at the "net" or the difference between the response of the economy to an oil price shock under alternate gasoline assumptions. A visual approach is deemed suitable and charts 28 to 38 depict this "net" difference. If this "net" is positive then the economy suffers less from the oil price shock under Phase 2 otherwise not. To recap, in chapter 1 we saw that the economy was relatively better off in the long-run under Phase 2. Although, percentage wise as well in absolute terms these numbers were not large enough.

Looking at the employment at a disaggregated level a similar picture is seen. For example, manufacturing gains only 100 jobs in 2001 and this gain even drops to zero in 2006.

Chapter 4

CONCLUDING REMARKS

The aim of this report was to investigate whether or not the negative effect of an oil price shock on the California economy is less severe under Phase 2 gasoline specifications. To this effect we simulated a model for the U.S. economy, shocked it with an oil price disturbance in the year 2000, and fed the output to a model for the California economy. During this process we made use of the California and the U.S. models used by our business forecasting group and certain modifications we made to them for this analysis. We found that the oil price shock effects on the Gross State Product (GSP), employment and prices were as expected, with all these three categories showing the expected behavior (employment and GSP fall whereas the prices increase). As the oil price shock affects the California economy in a different manner than it effects the U.S. economy, adjustments were made to this affect. This happens because only a certain proportion of the U.S. oil demand is subject to Phase 2 gasoline specifications, whereas, the entire state of California is covered by Phase 2.

Consequently, the response of California to the oil shock was more negative in relation to the U.S. economy. This implies that the response of the state and the local governments to an oil shock will be relatively larger than that of the federal government. Also, the effects of the oil shock are of a longer duration for California in comparison to the U.S. Thus both in the short-run and the long-run California's economy suffers relatively more from an oil price shock than the U.S. economy as a whole.

As far as the effect of the oil shock on the employment numbers at a 2 digit SIC code

level is concerned, we find that industries in services, finance and real estate suffer an immediate drop in their employment levels following an oil price shock, whereas the manufacturing sector suffers with a one year lag. The only industries to gain from this shock is the wholesale and the retail trade sector. This in our view-point is the effect of the continuing trend in both California and U.S. economy of growth of small sized firms which dominate the trade sector. On the other hand manufacturing sector recovers a few years later when the U.S. economy recovers from the oil shock as the majority of the California's manufacturing sector is export oriented both with respect to the rest of the U.S. and the world, e.g. motion pictures, aerospace and computers.

Regarding the question whether Phase 2 gasoline specifications will make California more or less vulnerable to an oil shock, our answer is that any beneficial effects will be very small both qualitatively and quantitatively, and will certainly be smaller than the social cost of the implementation of the reformulated program. The numbers are so small, even in absolute terms, that they can be attributed to the statistical noise inherent in any kind of simulation framework.

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Appendix A: Overview of the Forecasting Model for U.S.

The model employed by us is a quarterly econometric model of the U.S. economy built and maintained by the WEFA Group¹⁰. It is designed for both forecasting and policy analysis. This model is in the neo-Keynesian tradition, with important supply-side and financial influences. The major flows in the model are illustrated in the accompanying chart.

The circular movement of economic activity is represented by the links between the corner boxes in the figure. Various income streams drive the component of the final demand in the model. The level and mix of output depend on movements in the components of demand. For example, employment a major determinant of income, responds to changes in output. Monetary and fiscal conditions and a wage/price/supply system interact with these major flows of economic behavior.

The components of demand are modelled from the bottom up using standard approaches which employ various measures of permanent income/output and relative prices. The model also includes a detailed trade sector in which eight categories of both exports and imports are modeled individually. Each is related to appropriate income/demand variables as well as to relative prices.

Most importantly, the model contains a fully specified energy sector. These equations effect and are affected by the rest of the broadly defined sectors in the model. In other words,

¹⁰ For complete description of the equations in the model one is referred to WEFA booklet (1994).

the model is in the spirit of general equilibrium analysis where every equation depends on each other. A solution to this simultaneous system is the projected forecast or the simulation which in turn is governed by manipulating the external levers or the exogenous variables of the model. In the current analysis, price of the crude oil and price of the petroleum products are the relevant exogenous variables. The specific equations that correspond to this sector are listed below:

'Domestic Demand For Petroleum, Mil of Barrels'

$$\log(\text{QEBLOIL}/(\text{GDP87}-\text{CESTRNXAR87}-\text{CENENE87}))$$

$$0.9601 * \log((\text{cestrnXAR87}+\text{cenene87})/(\text{GDP87}-\text{CENENE87}-\text{CESTRNXAR87})) + 54.8727 * 1/\text{ttrend} - 2.6300;$$

'Domestic Supply Of Petroleum, Mil of Barrels'

$$\log(\text{QEBLOILDOM}) = 0.0616 * \log(\text{ppirpp}/\text{pdigdp}) + 34.7555 * 1/\text{ttrend} + 2.0693;$$

' Total Needed Imports, Mil of Barrels'

$$\log(\text{IMOIL87}) = \log(\text{qebloil}-\text{QEBLOILDOM});$$

where QEBLOIL = Total domestic demand of oil,

GDP87 = GDP in 1987 prices,

CESTRNXAR87 = Consumption expenditures, Transportation services, other in 1987 prices

CENENE87 = Energy expenditures, in 1987 prices

ttrend = time trend,

QEBLOILDOM = Petroleum supply domestic

ppirpp = Producer price index, Fuels and related products

pdgdp = Fixed-weight price index, GDP

Imoil87 = Imports Merchandise , Petroleum & products, in 1987 prices.

Although the price of oil and the petroleum products is not explicitly stated in the equations above, they are present via their effect on the energy and transportation expenditures which in turn are dependent upon and affect the rest of the economy's variables. In this sense the equations of the model are interdependent.

Appendix B: Overview of the Forecasting

Model for California Economy

The UCLA business forecasting model for California consists of several hundred variables which are in the California Database developed and maintained by the Economics Group of Security Pacific Corporation. Almost all of the exogenous variables in the California model are U.S. variables¹¹. This means that in order to simulate the California model, one must supply the model with data for these U.S. variables over the forecast interval. That model has been described in the previous appendix.

The model contains significant linkages between net immigration, population, the labor force, unemployment, and personal income. For example, real own wage effects better reflect California's need to compete internationally, particularly in manufacturing; and the ramifications of California's traditional growth advantage over the rest of the U.S. include a higher rate of immigration to the state, slowing the rate of growth in per capita real income and raising the state's unemployment rate.

The most important segment of the model is the "Base and Nonbase Employment Multiplier". This is the relationship in the model between the base and the nonbase employment. In the model, base or the manufacturing employment is mostly driven by U.S. variables; thus given the U.S. forecast this portion of state employment, representing about 20 percent of the state's total, is determined. The empirical justification for this structure is that manufacturing output is far more export-oriented than services employment and, hence, much

A detailed description for the model is contained in the write-up by Hensley (1986).

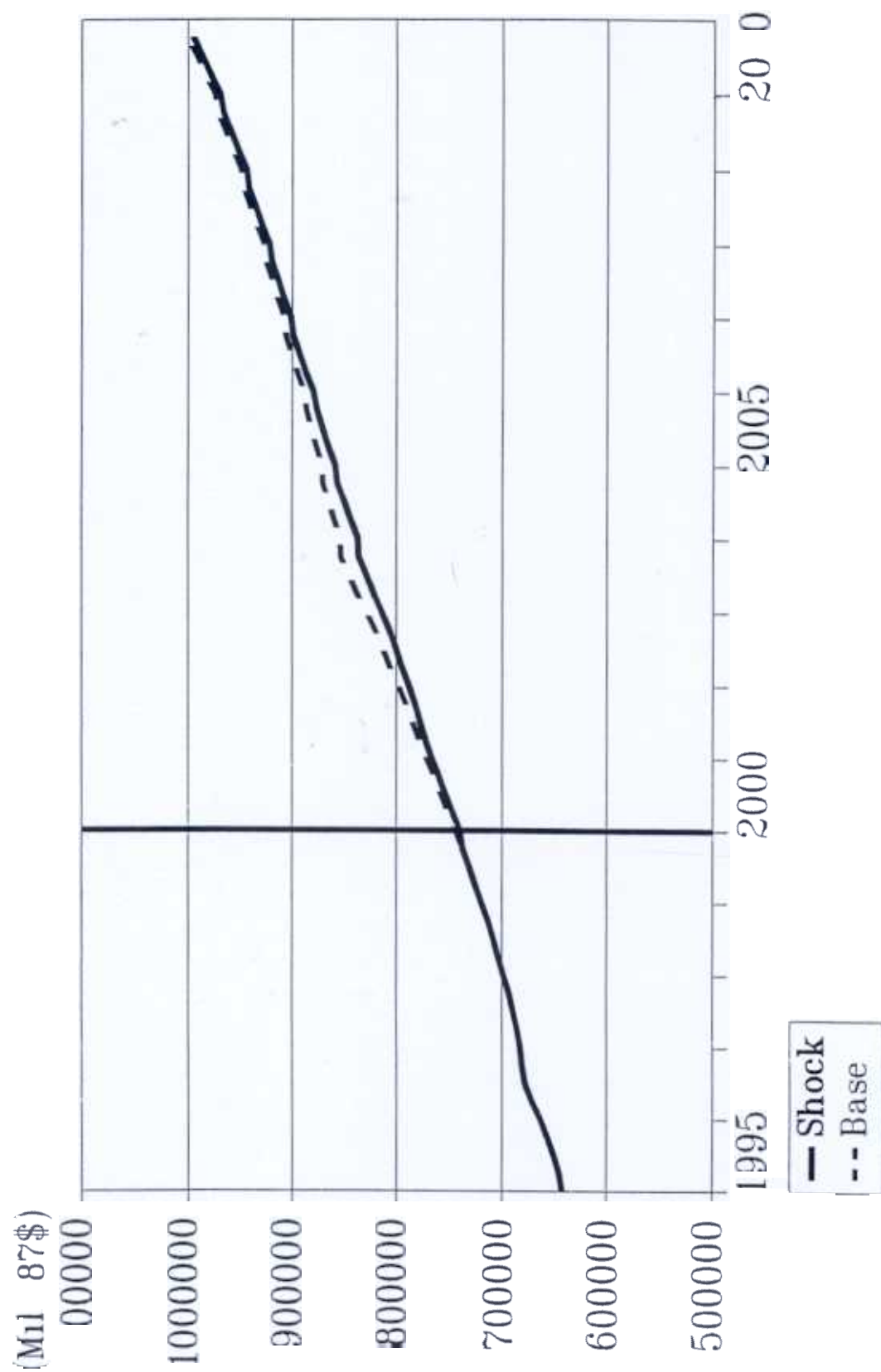
more dependent upon national and international economic conditions. But this structure also serves a valuable modelling purpose.

By qualitatively fixing a substantial portion of the state's employment from variables given outside the state model, the degree of simultaneity in the model is reduced to manageable proportions. The model then answers the following important question. For every new manufacturing job in the state, how many total jobs result in both the manufacturing and non-manufacturing sectors combined? As the newly created jobs lead to more income and more spending, this leads to the multiplier effect.

The complete model is represented in the flowchart on the next page. The individual loops in the model show the link between population and dwellings, net immigration and state employment, and base and nonbase employment. The key variable linking all the sectors is the gap between the state's unemployment rate and that of the U.S. as a whole. The main channel is the multiplier effect discussed above.

Appendix C Charts for the California Economy

Gross State Product Reformulate Gas Case Shock Vs Base



Real Personal Income Shock Vs Base

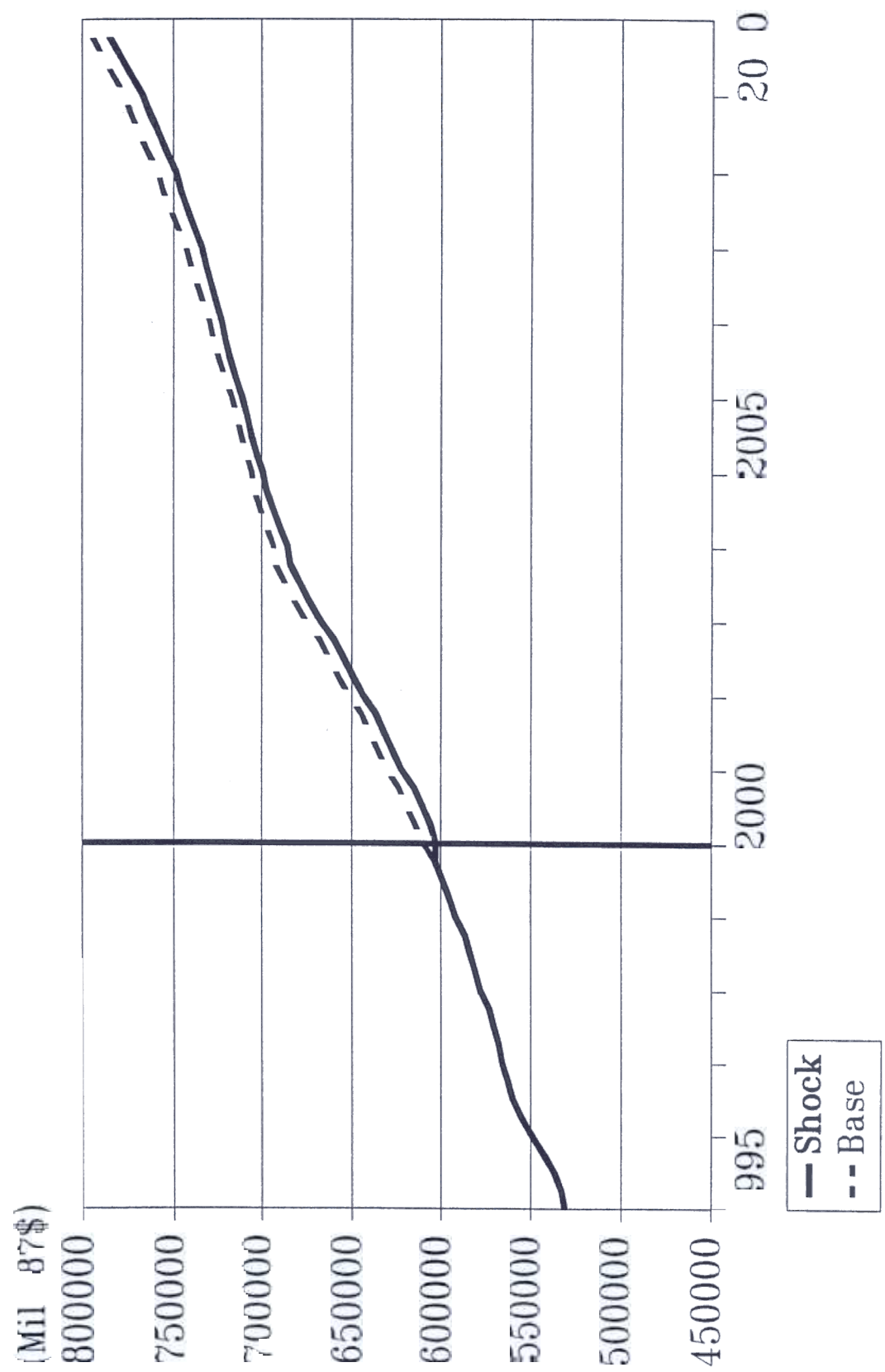
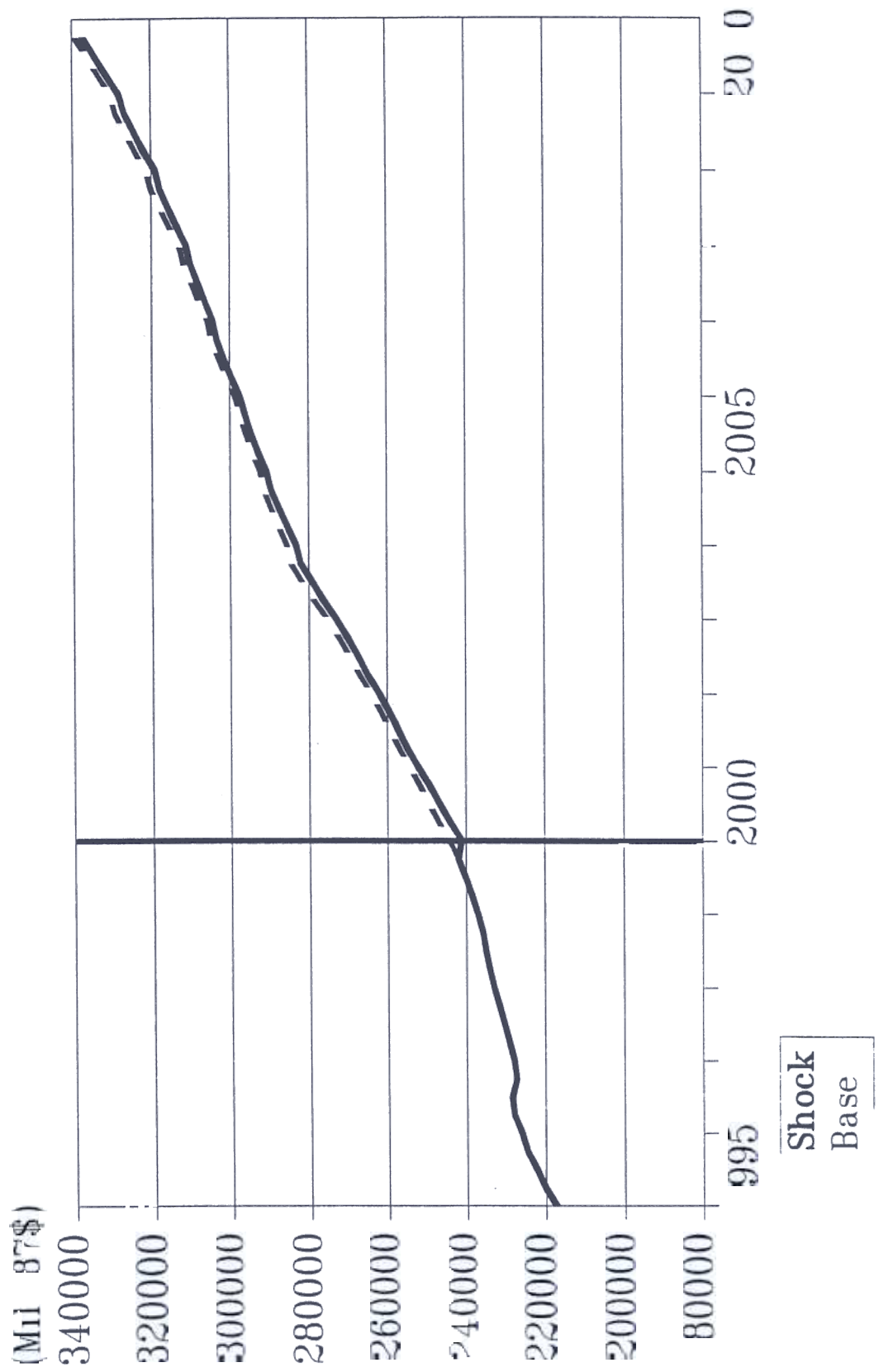


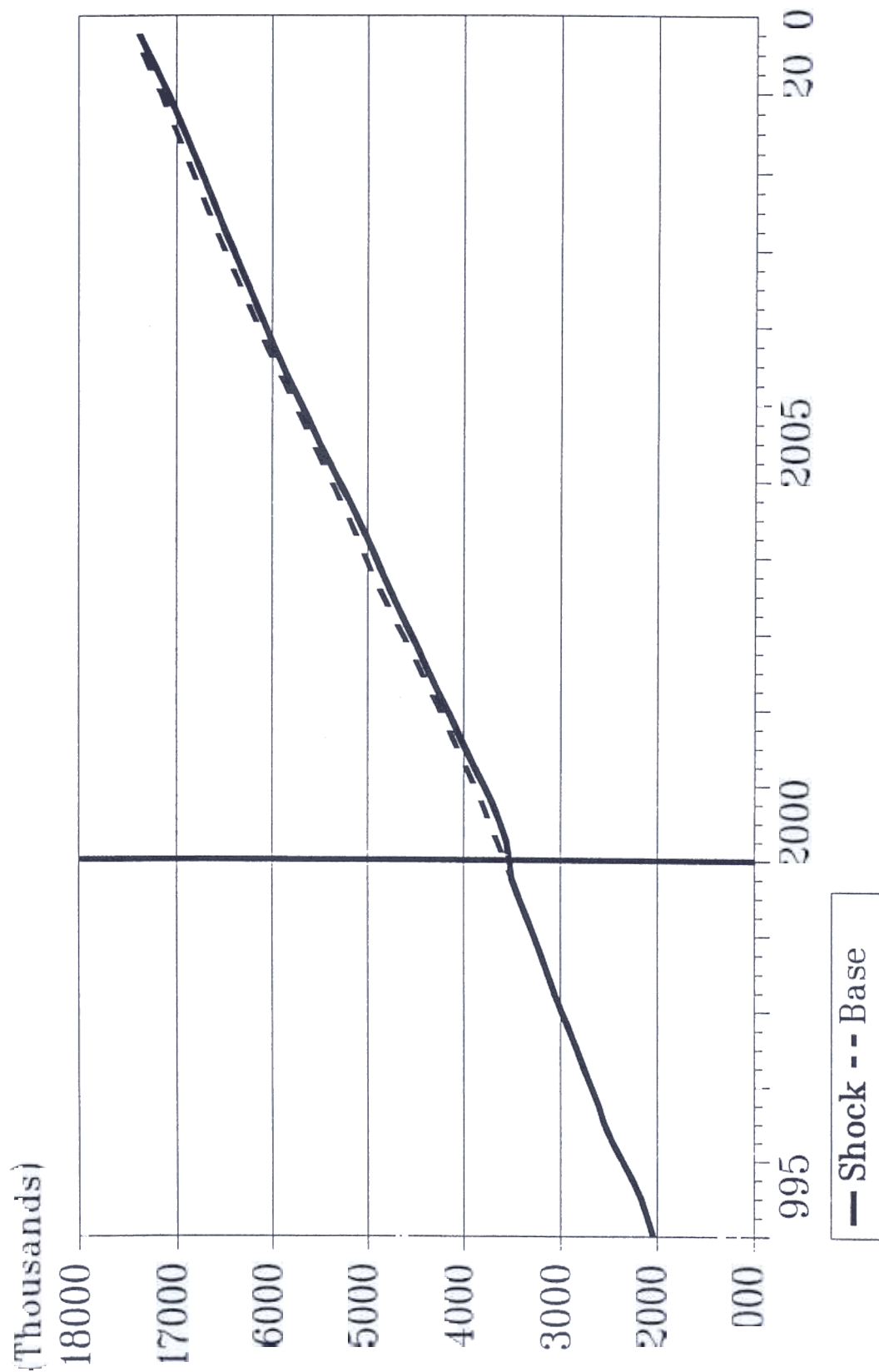
Chart 2.

Real Taxable Sales Reformulate Gas Case Shock Vs Base

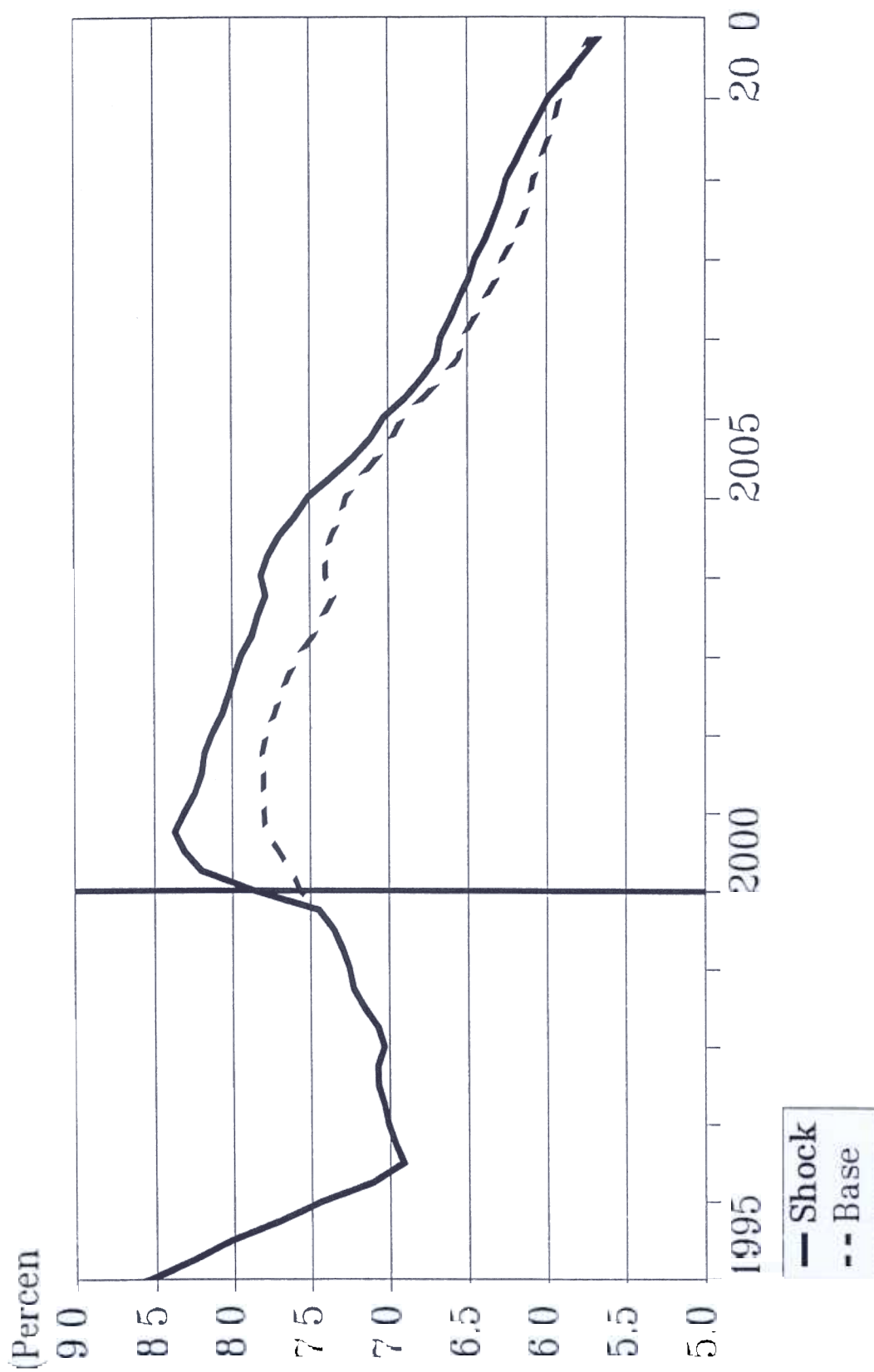


Chart

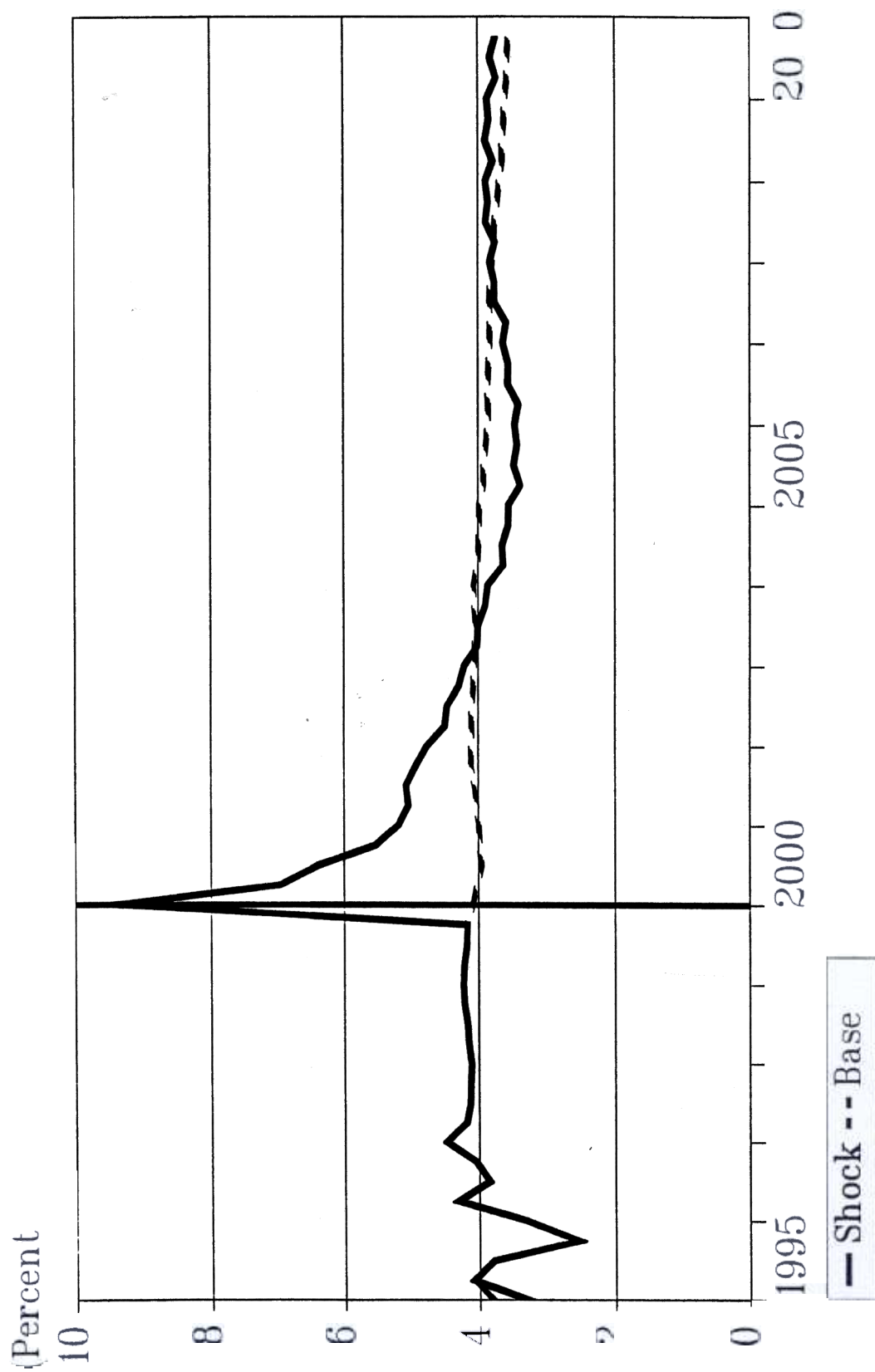
Nonfarm Employment Reformulated Gas Case Shock Vs Base



Unemployment Rate Gas Case Shock Vs Base

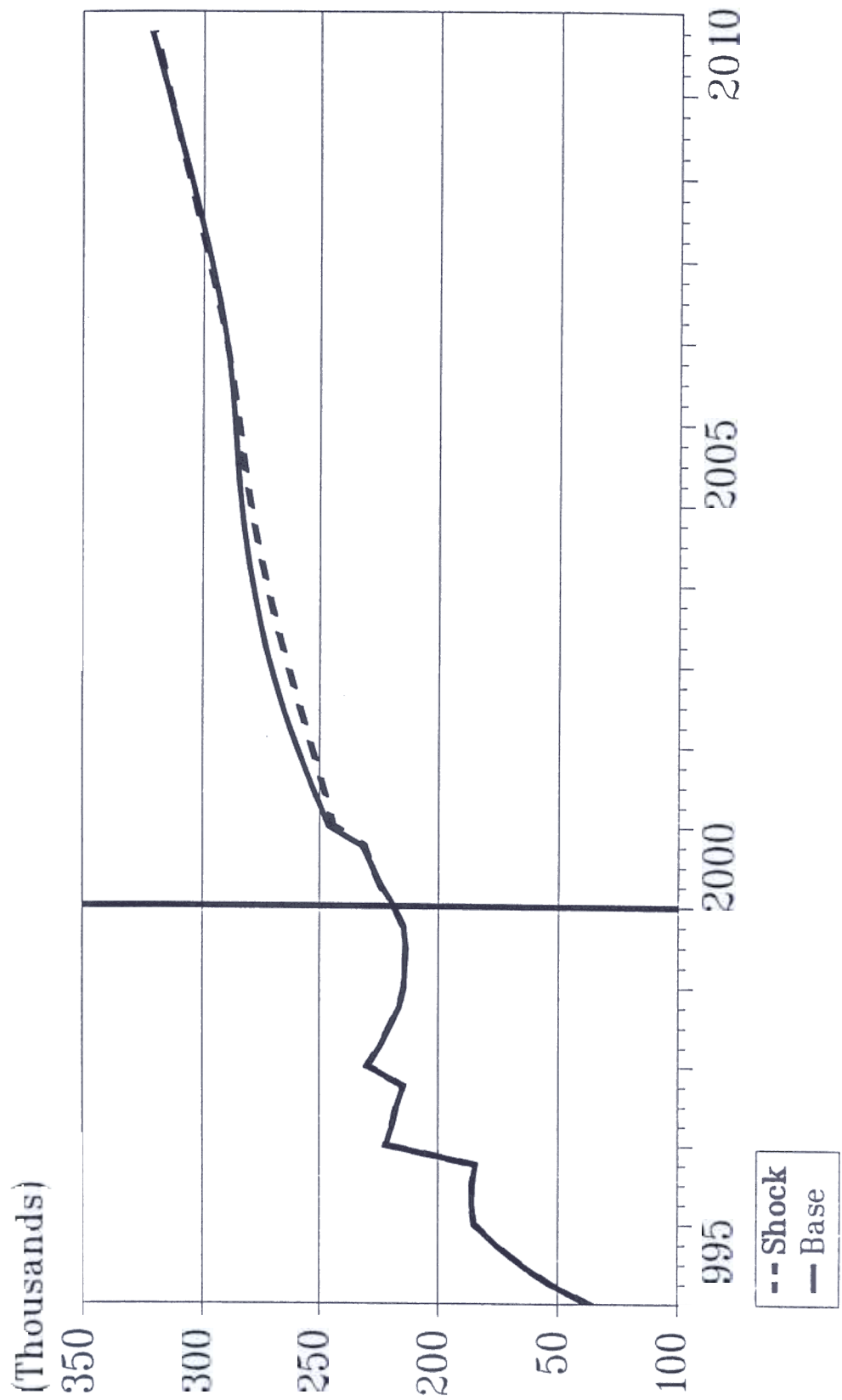


Consumer Price Inflation Reformulated Gas Case Shock Vs Base



New Residential Units Through Building Permits

Reformulate Gas Case Shock Vs Base



Net In Migration Reformulate Gas Case Shock Vs Base

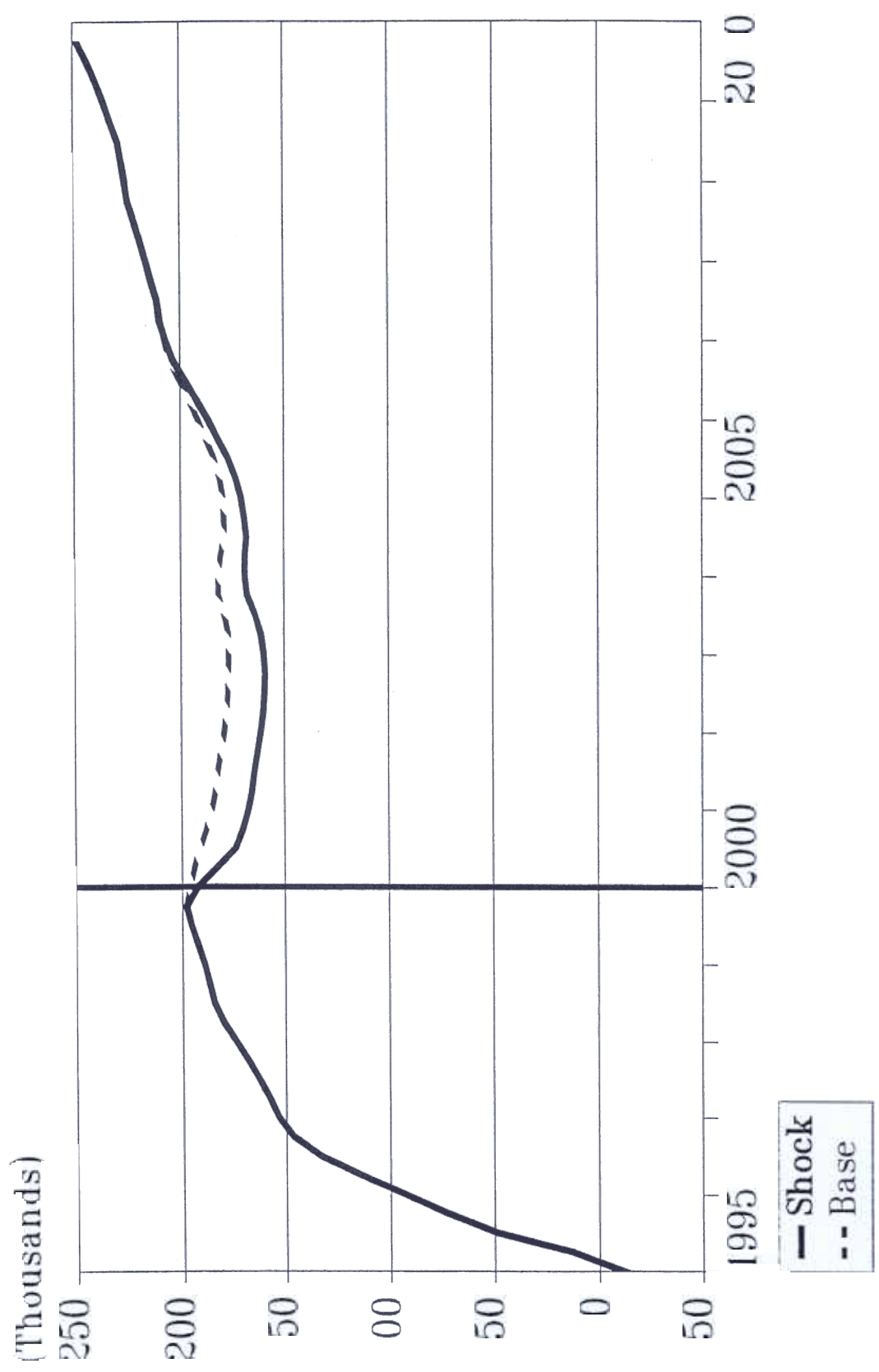
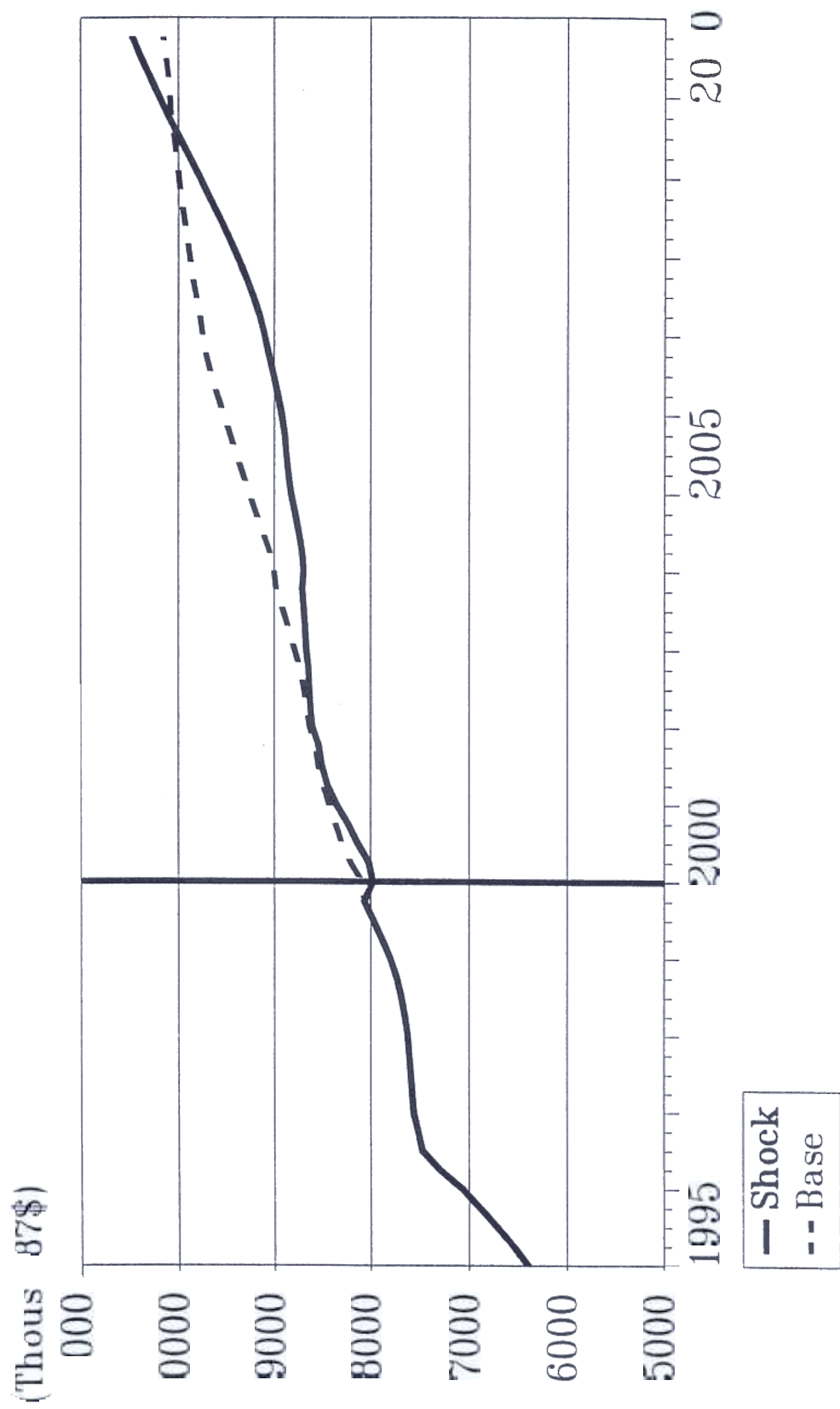
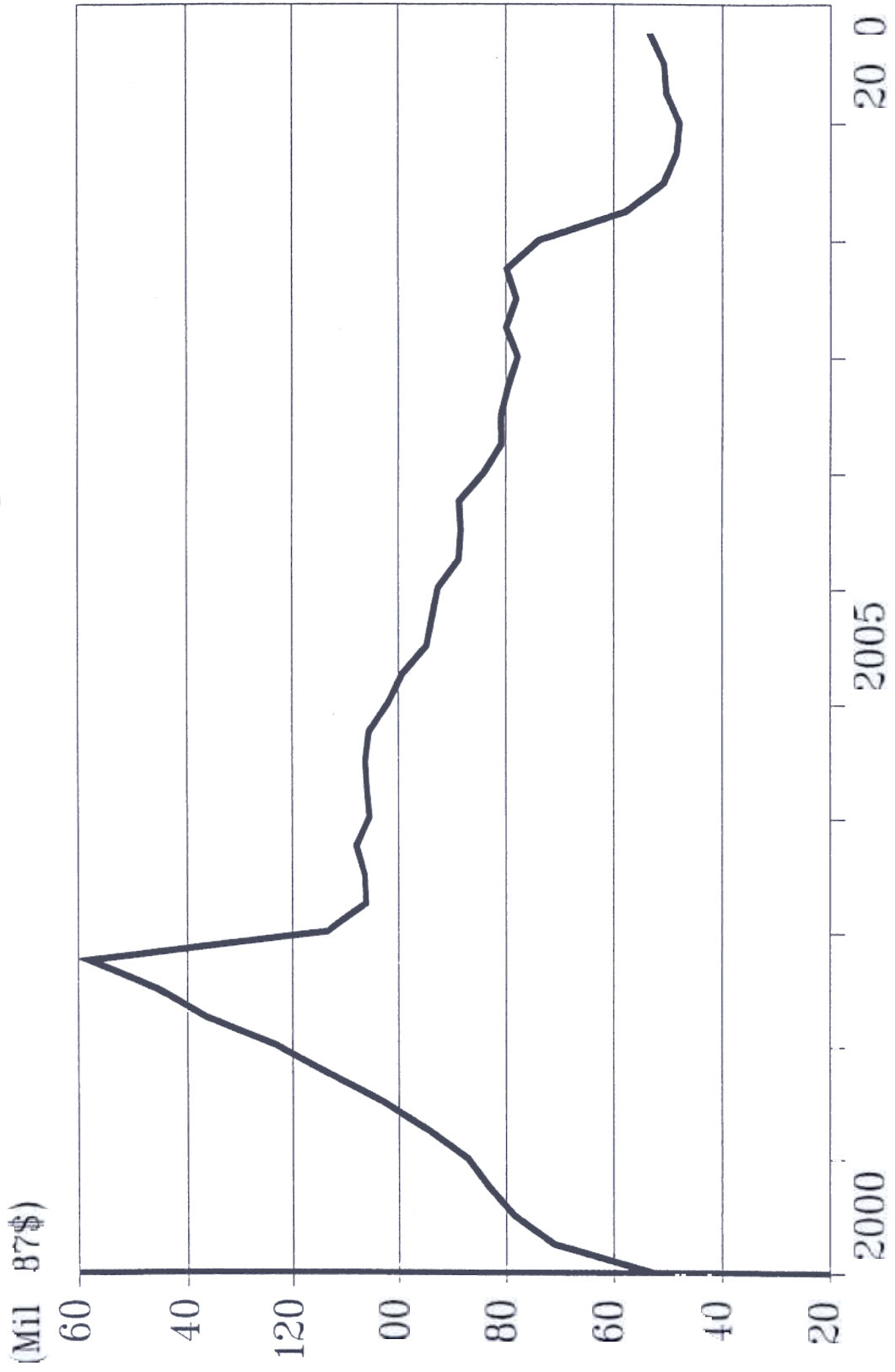


Chart 8.

Real Value of Non residential Construction Reformulate Gas Case Shock Vs Base

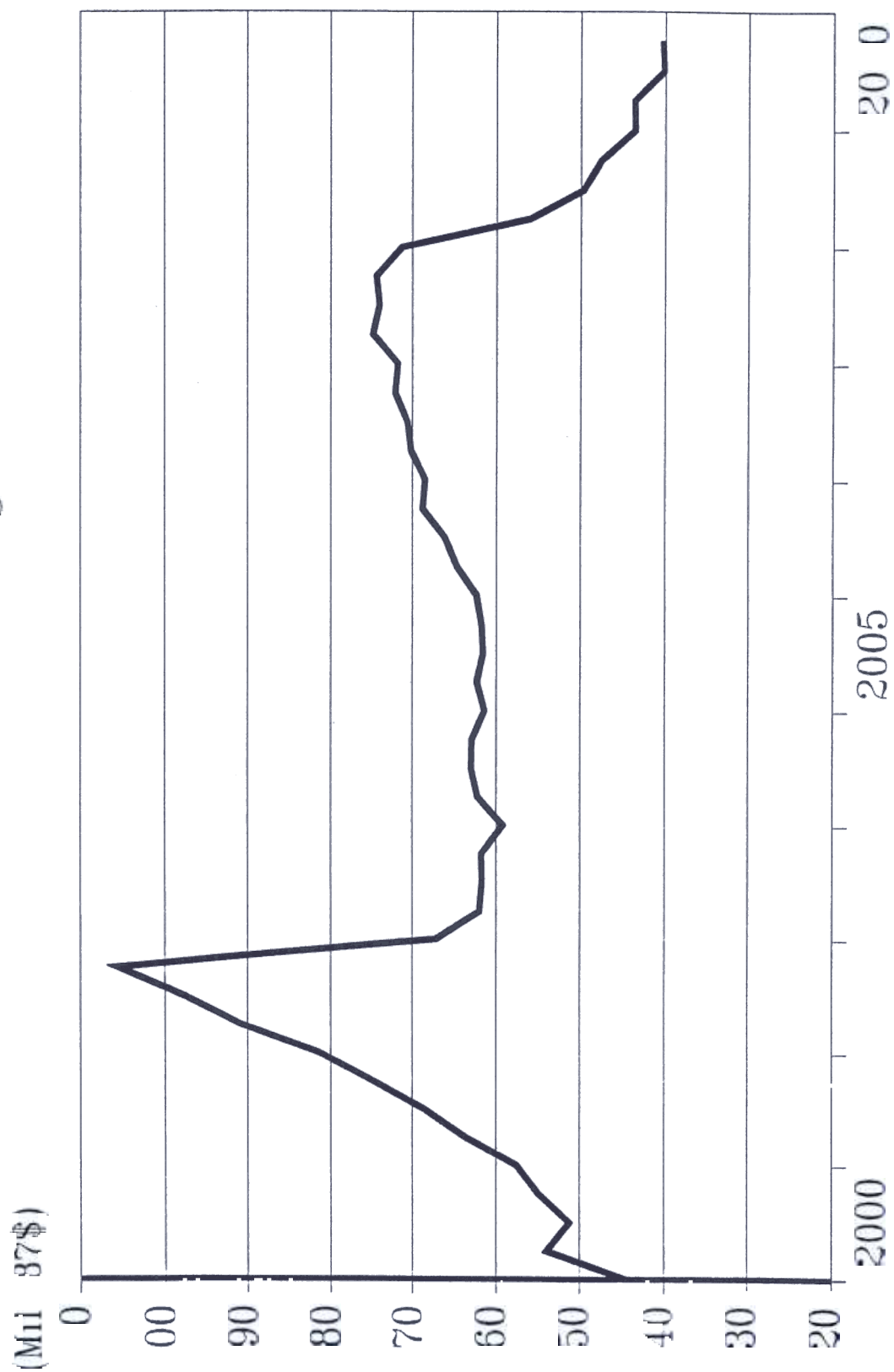


Gross State Product Reformulate Shock Minus Regular Gas Shock



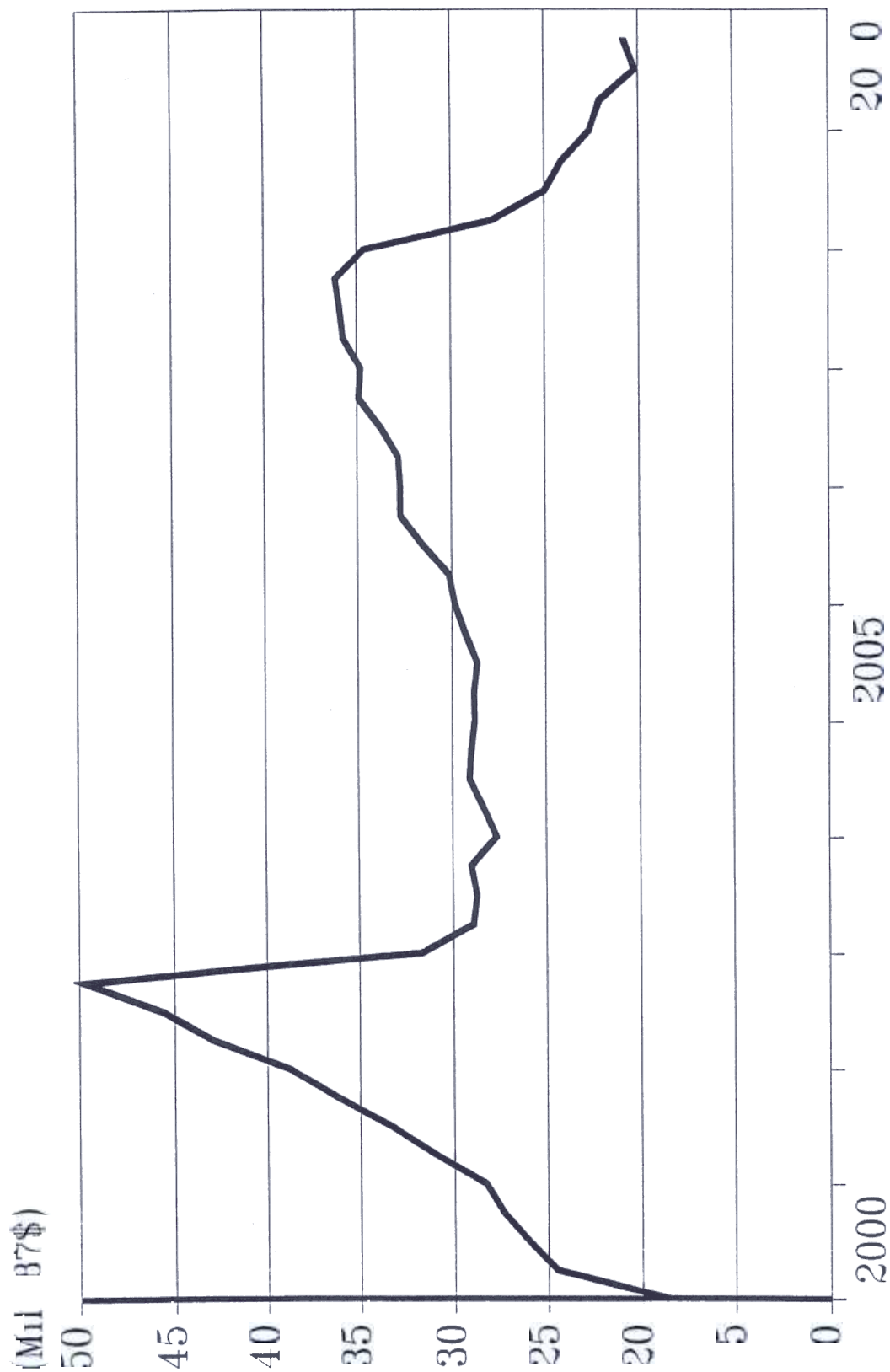
Chart

Real Personal Income Reform and Shock Minus Regular Gas Shock

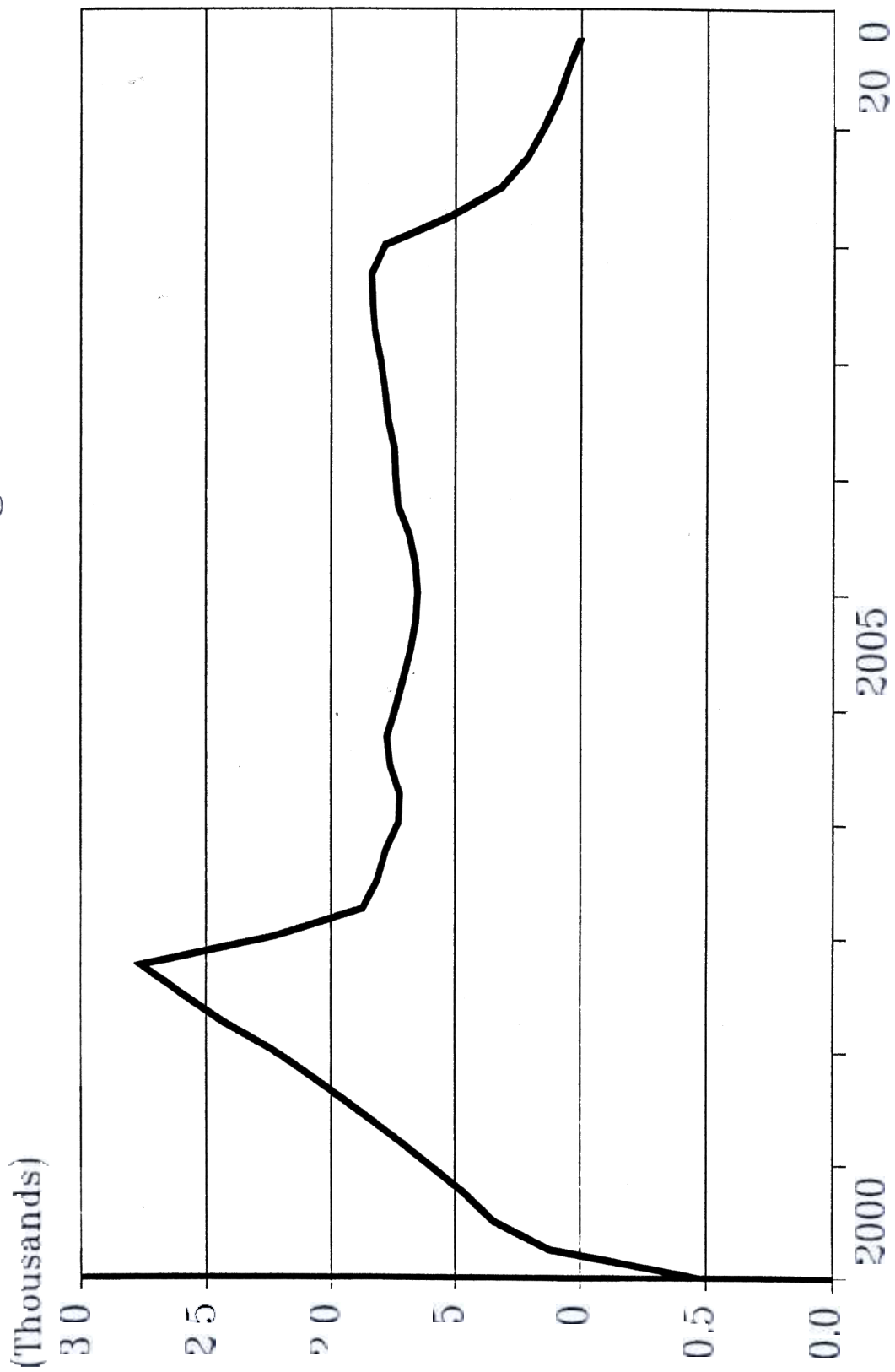


Chart

Real Taxable Sales Reformulate Shock Minus Regular Gas Shock

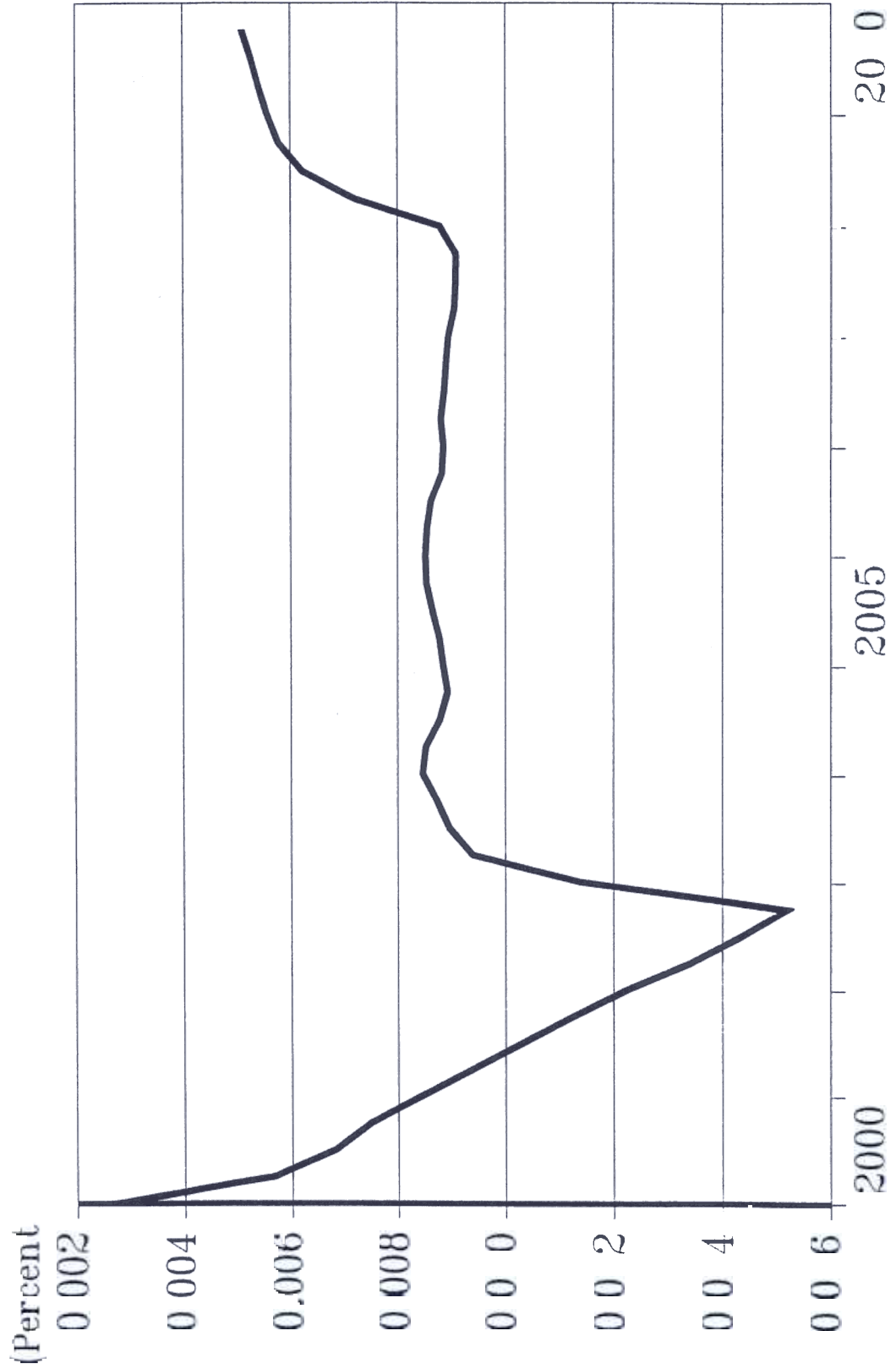


Nonfarm Employment Reformulate Shock Minus Regular Gas Shock

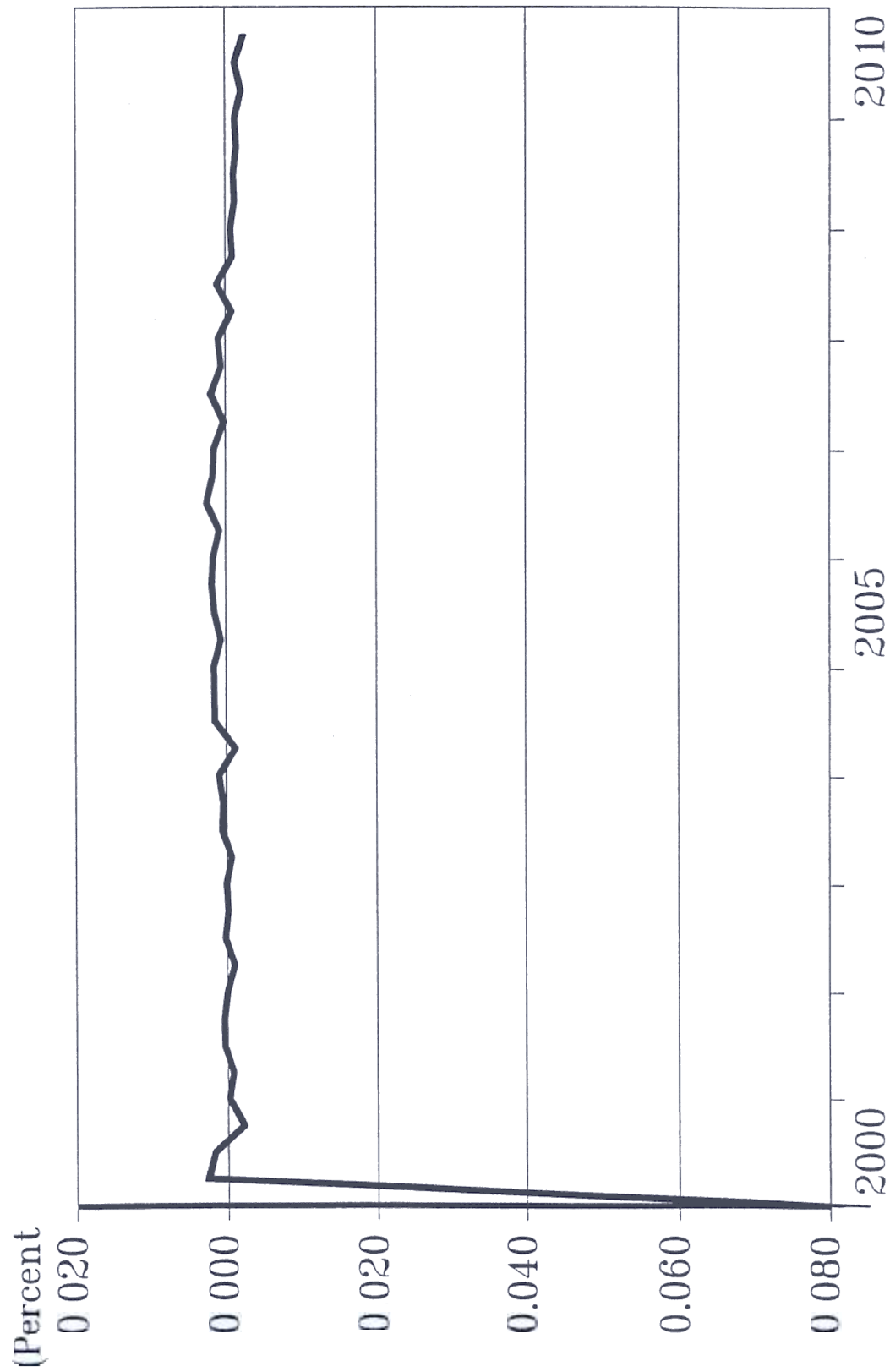


Chart

Unemployment Rate
Reformulate Shock Minus Regular Gas Shock

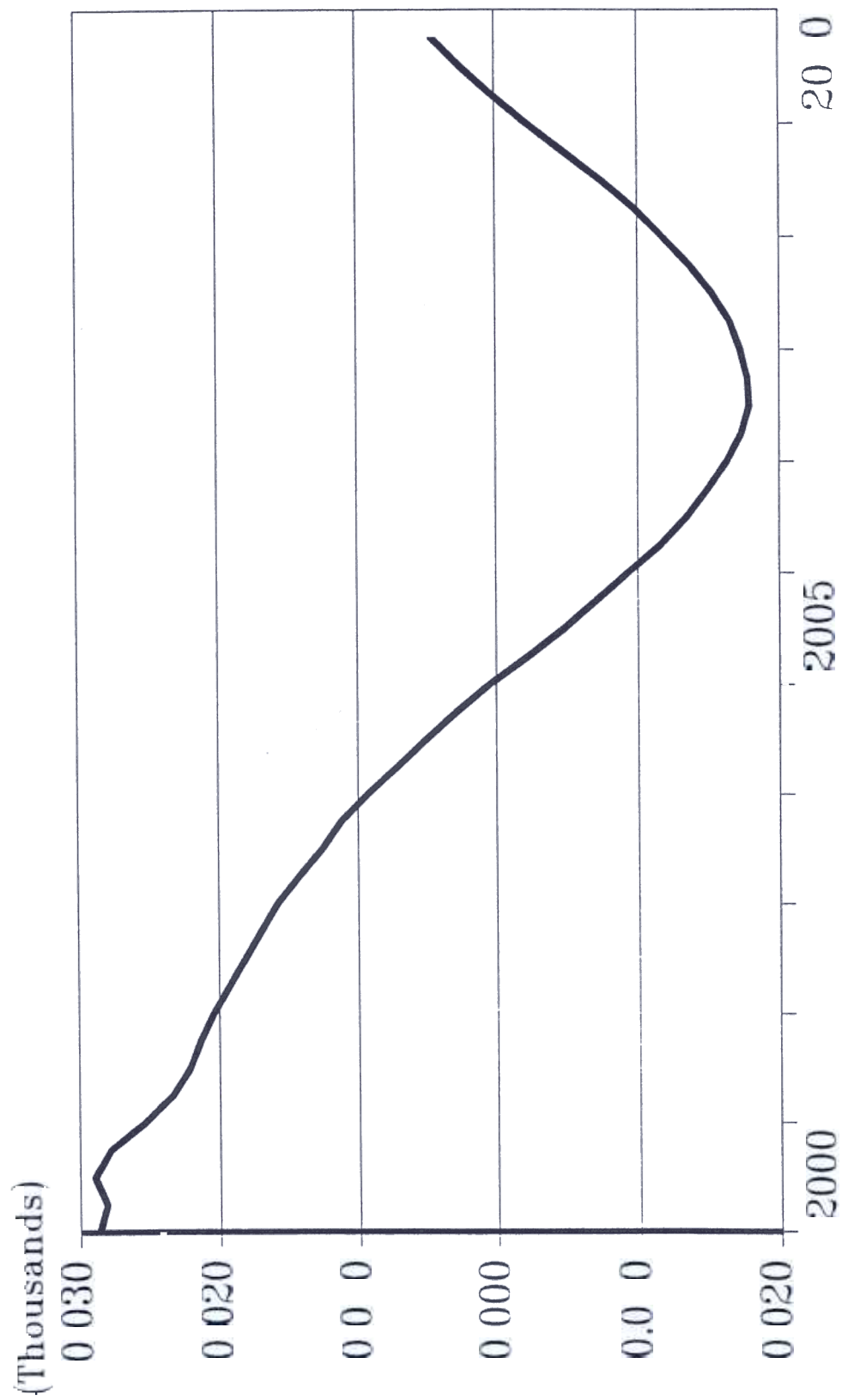


Consumer Price Inflation Reformulate Shock Minus Regular Gas Shock



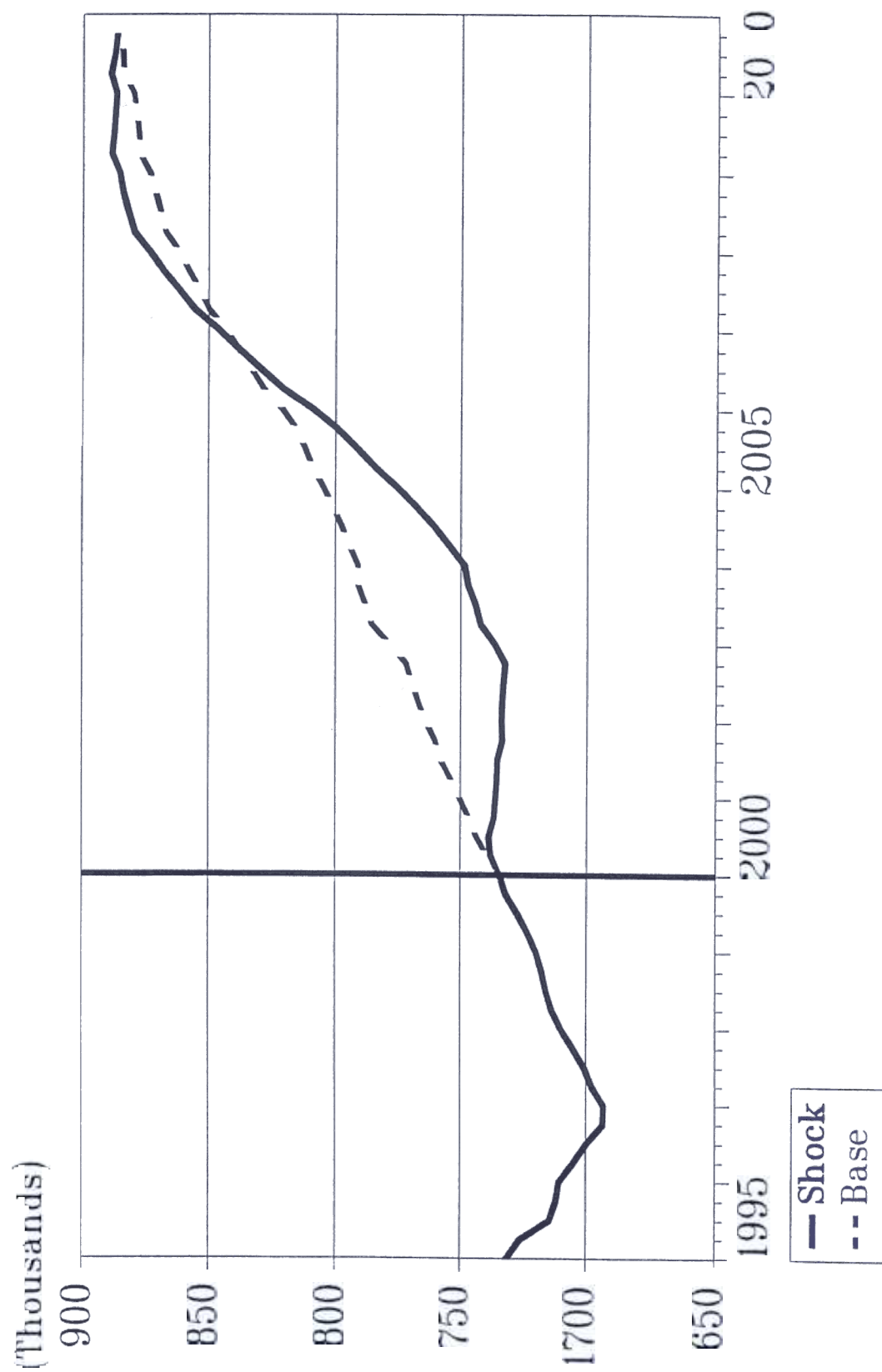
Chart

New Resident a Un ts Through Bu ding Perm ts Reformu ate Shock Minus Regular Gas Shock

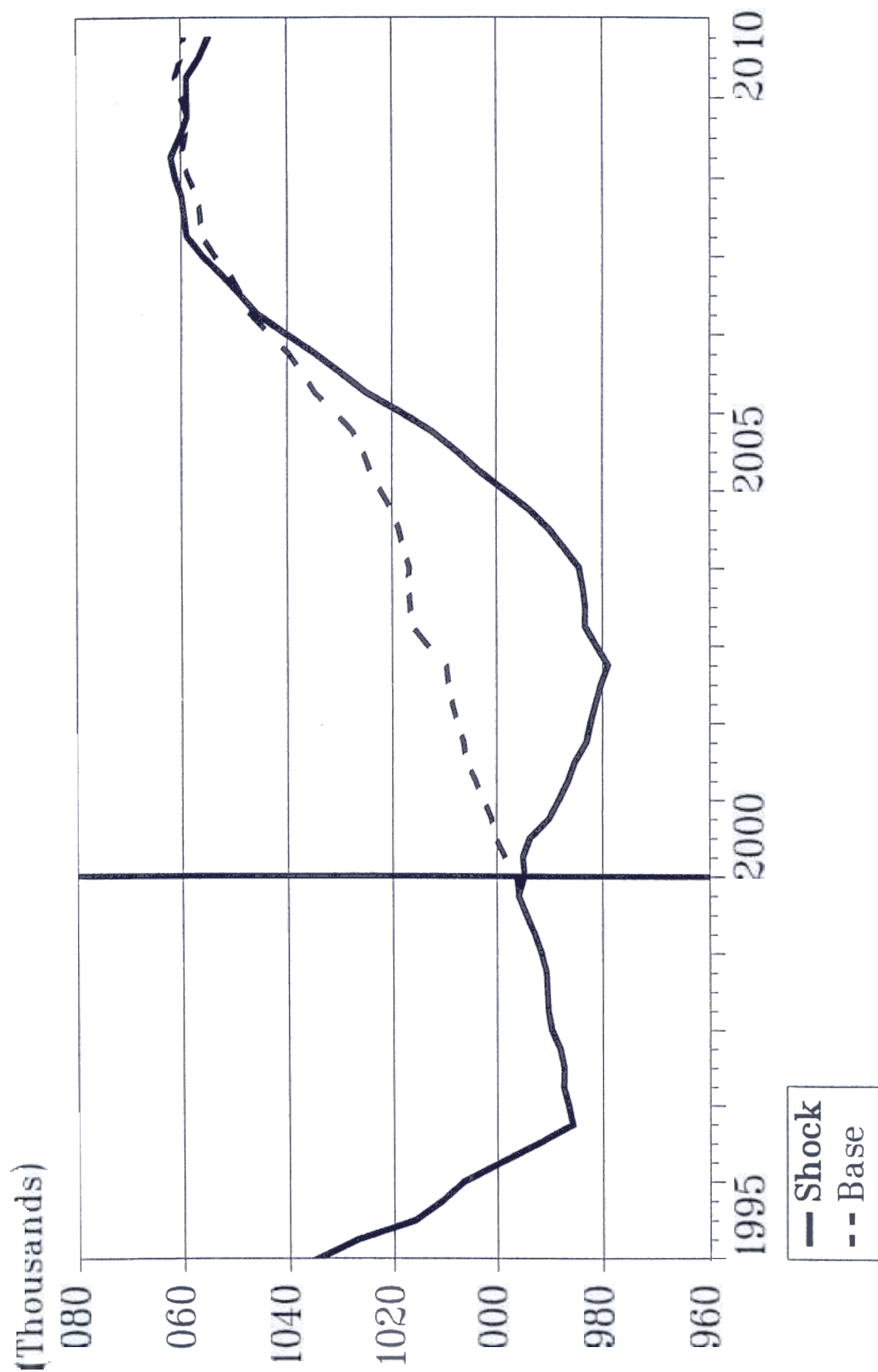


Chart

Employment in Manufacturing Reformulate Gas Case Shock Vs Base



Employment in Manufacturing Durables Reformulate Gas Case Shock Vs Base



Employment in Manufacturing Non Durables Reformulate Gas Case Shock Vs Base

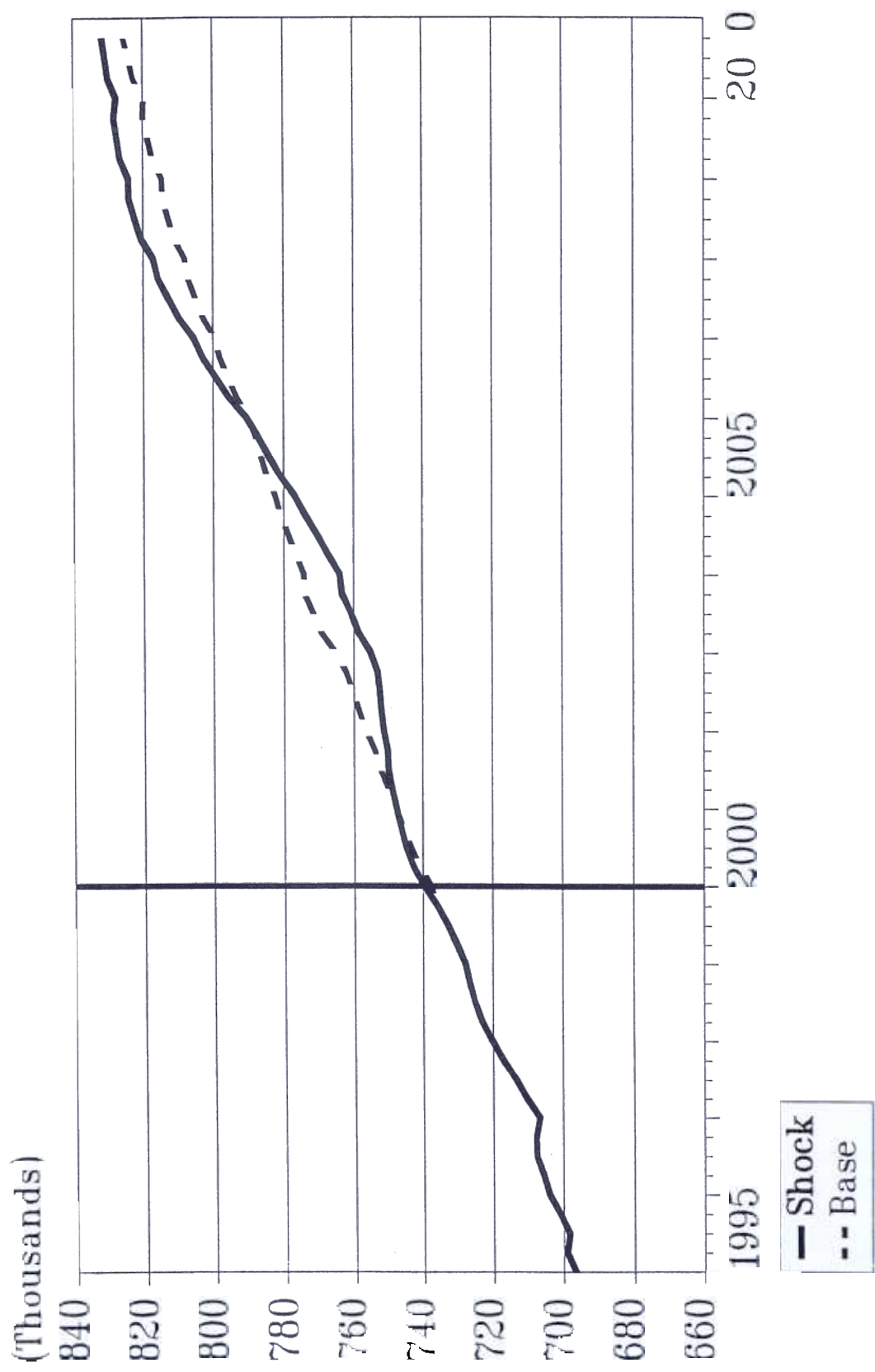
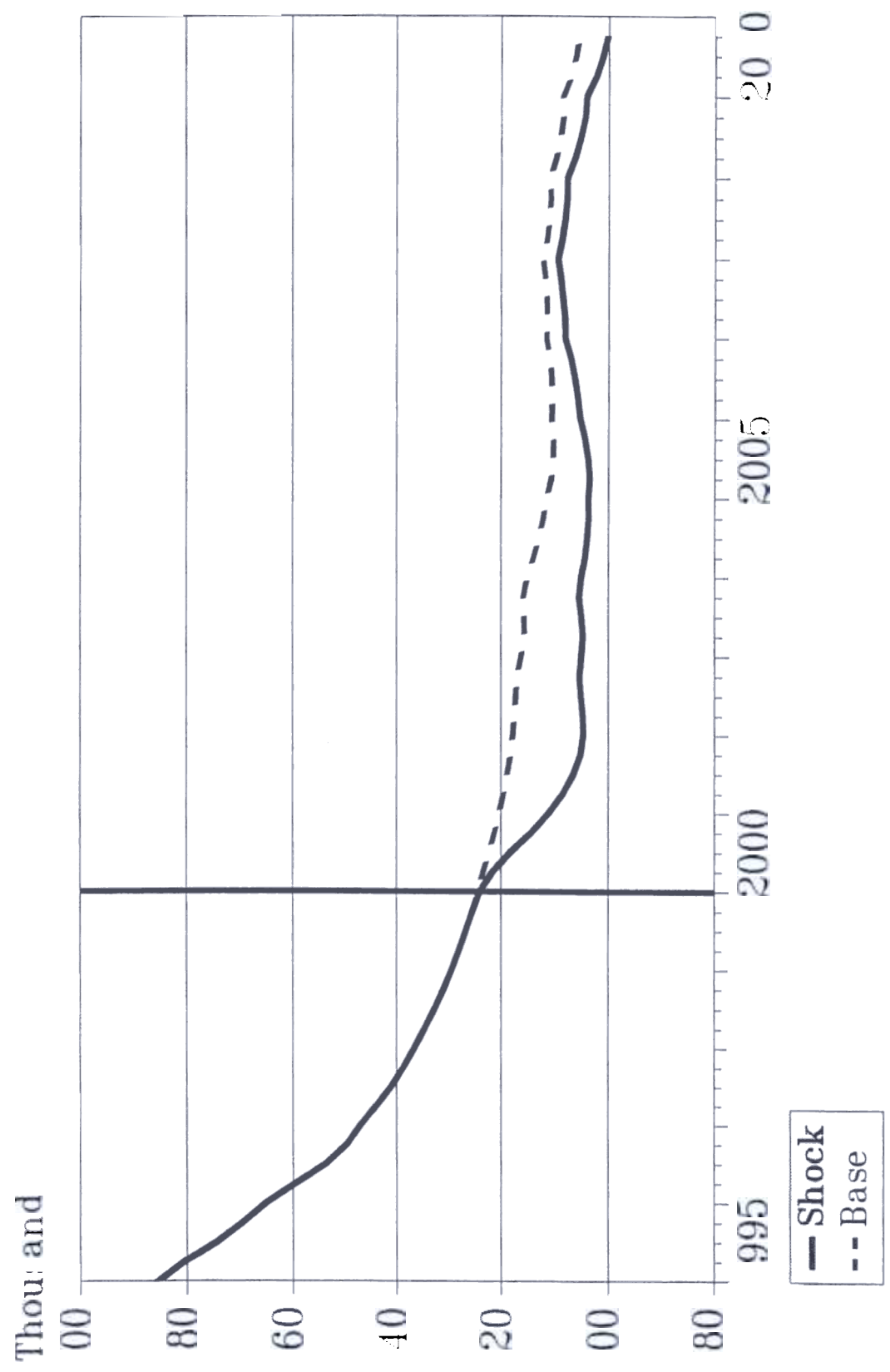


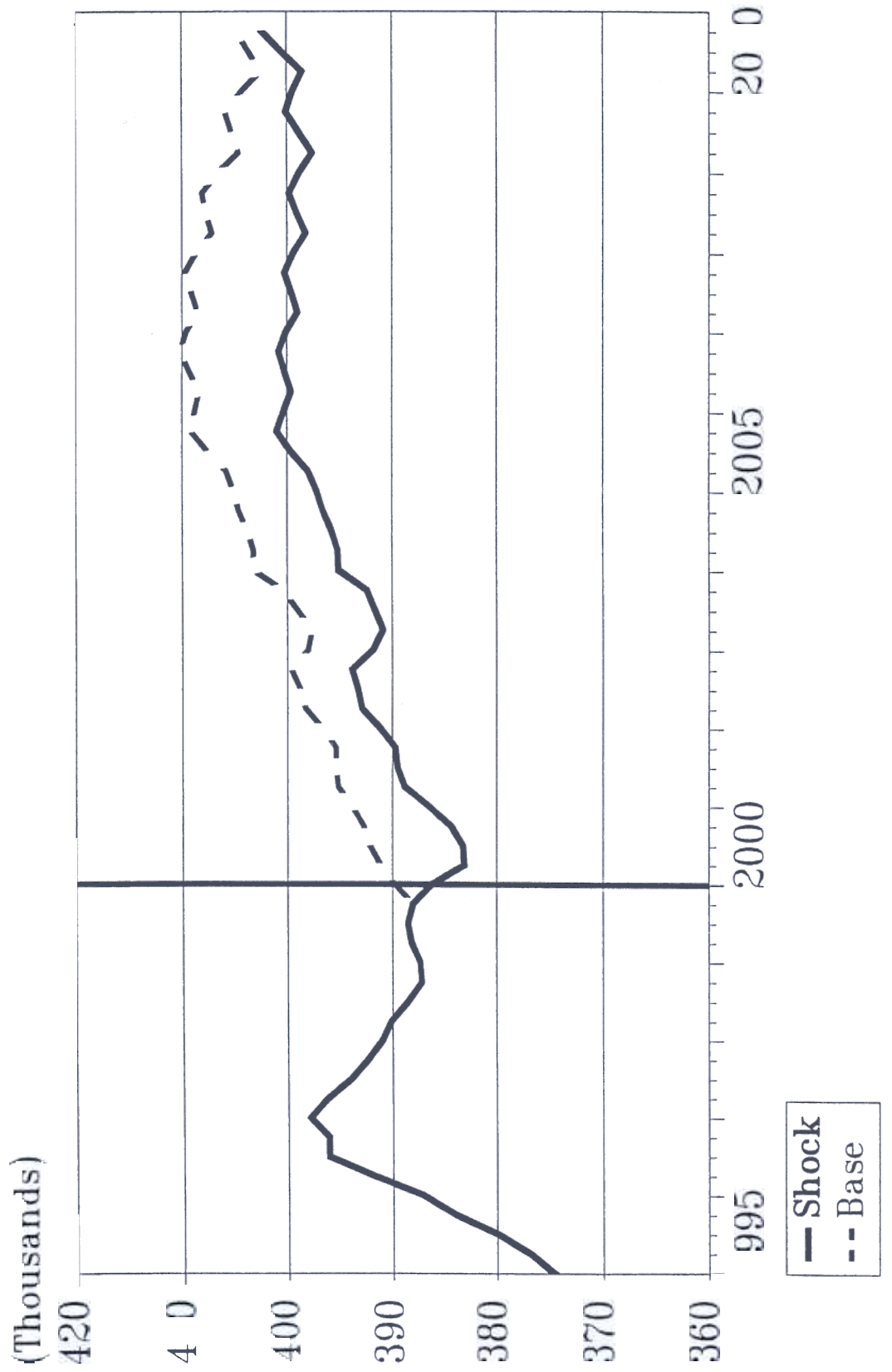
Chart 9.

Employment in Aerospace Manufacturing Reformulated Gas Case Shock Vs Base

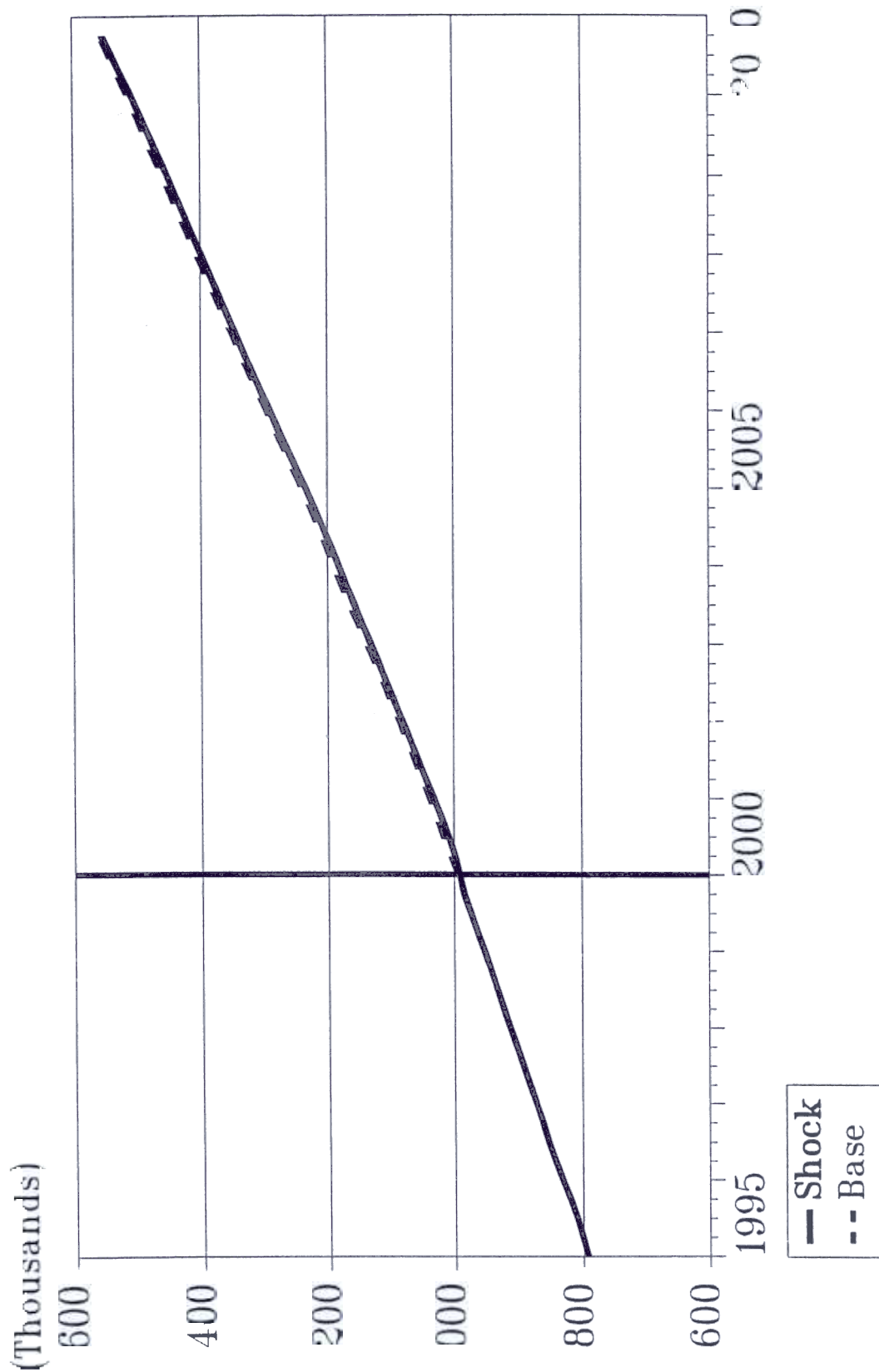


Chart

Employment in Finance Reformulate Gas Case Shock Vs Base



Employment in Business Services Reformate Gas Case Shock Vs Base



Employment in Motion Pictures Reformulate Gas Case Shock Vs Base

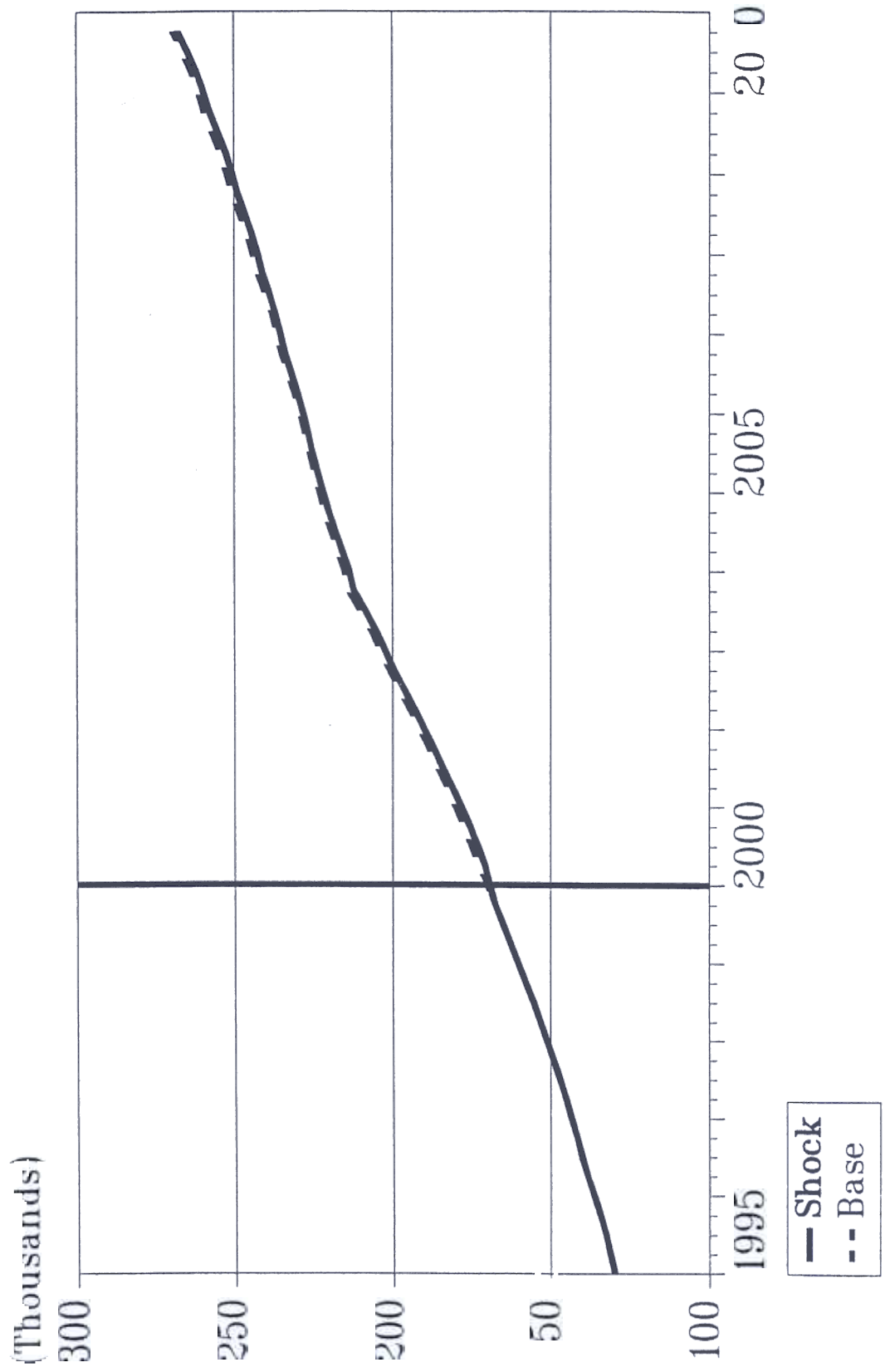
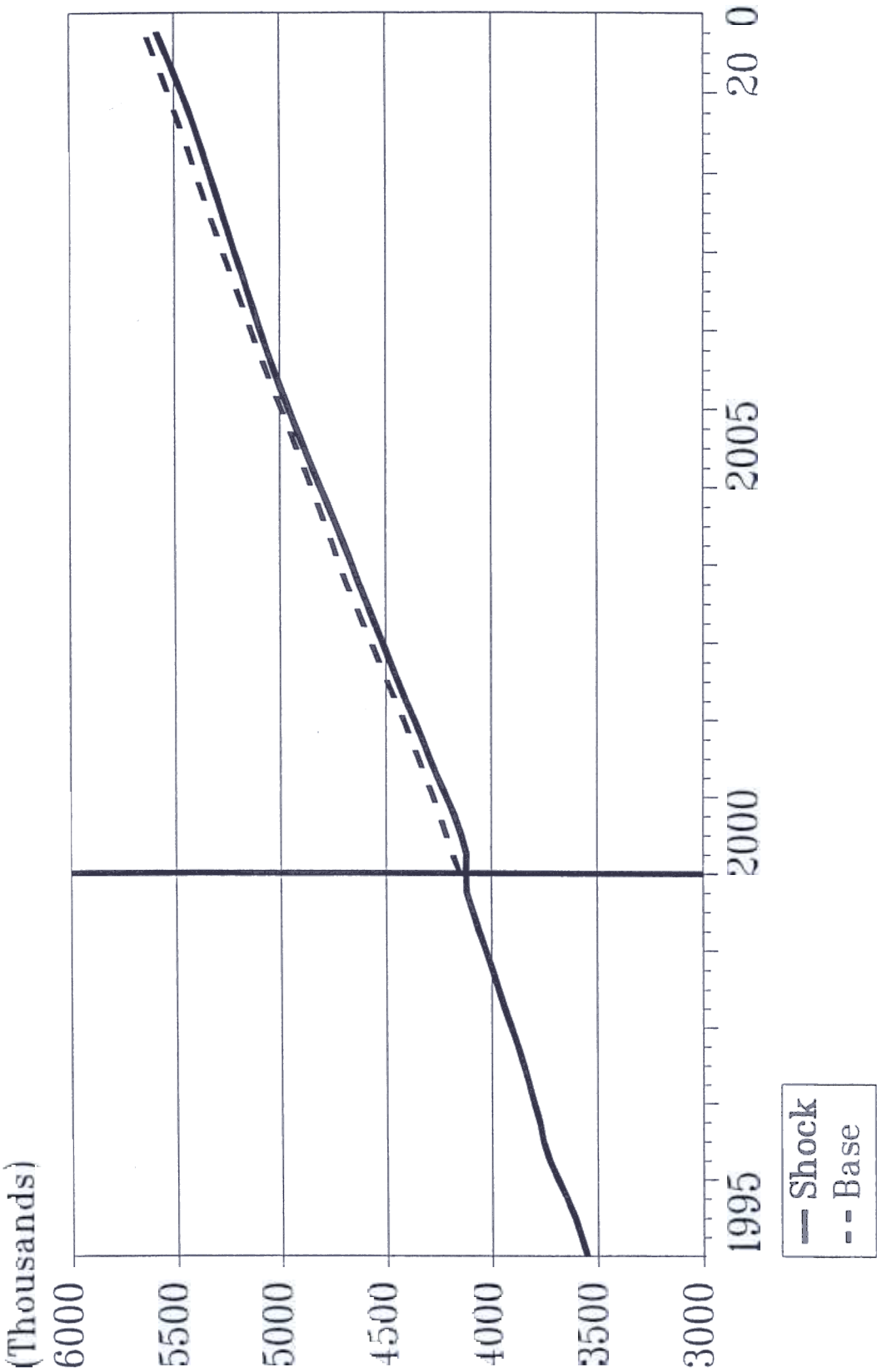


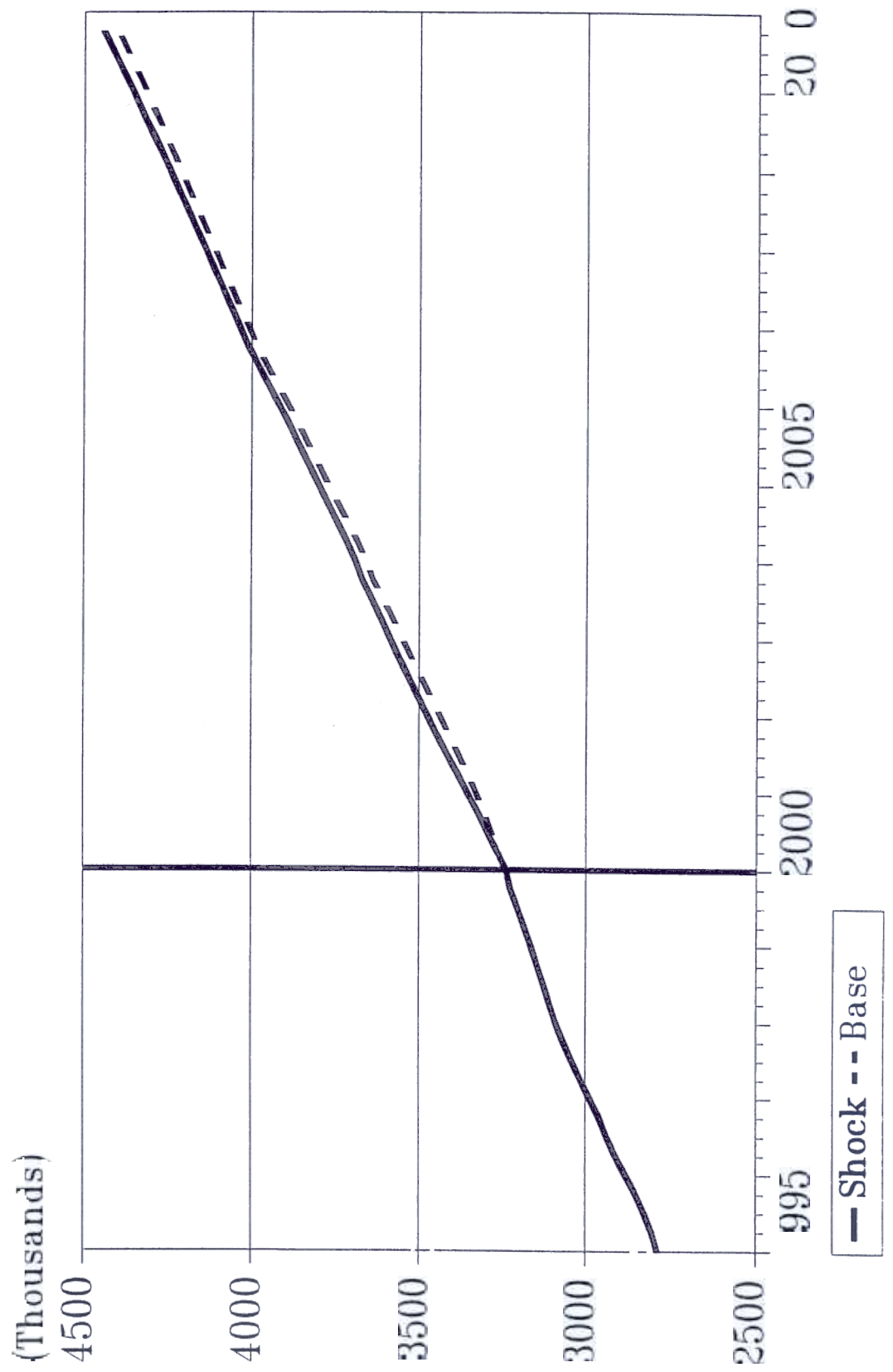
Chart 13.

Chart 24

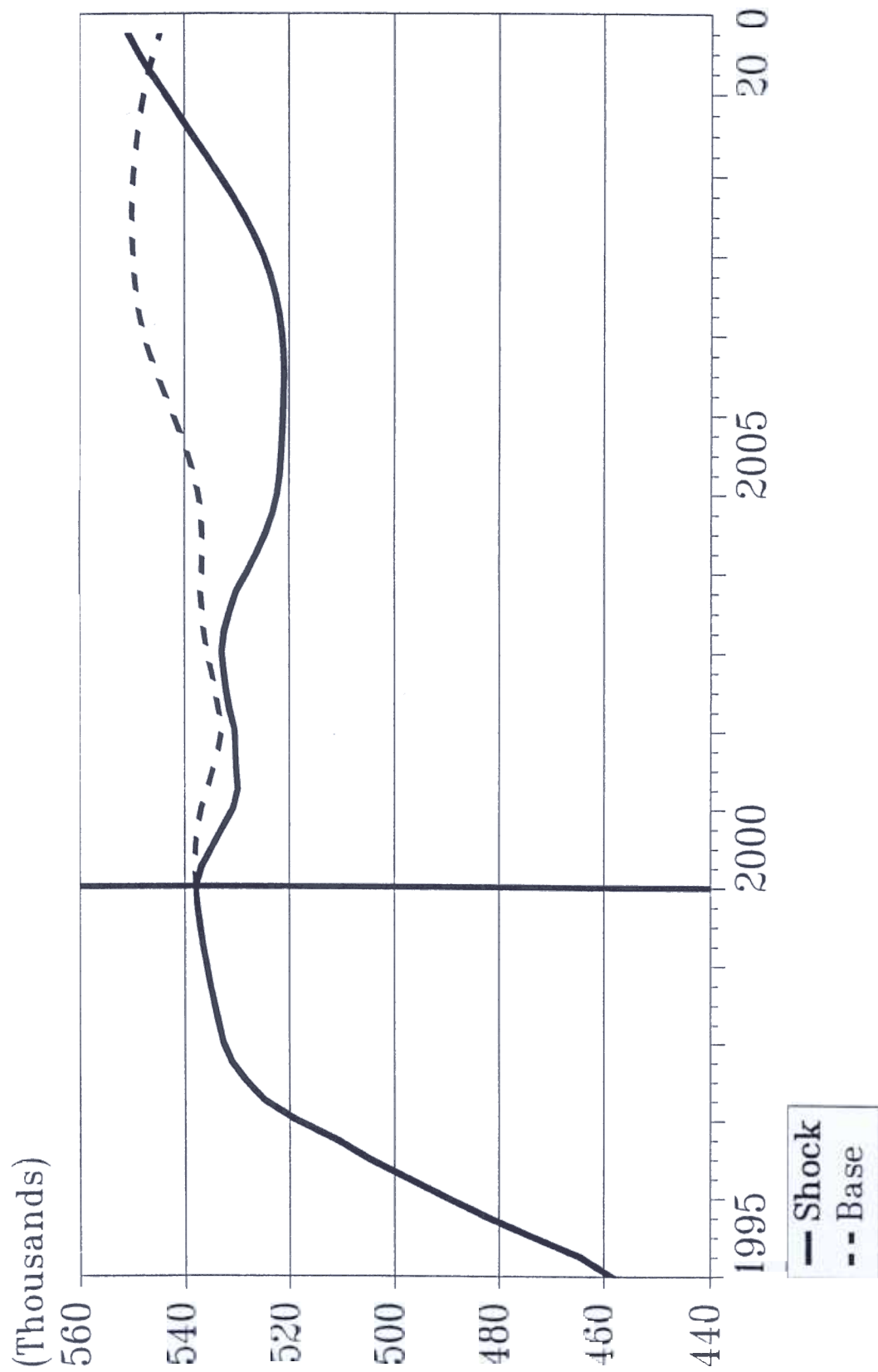
Employment in Services Reformulate Gas Case Shock Vs Base



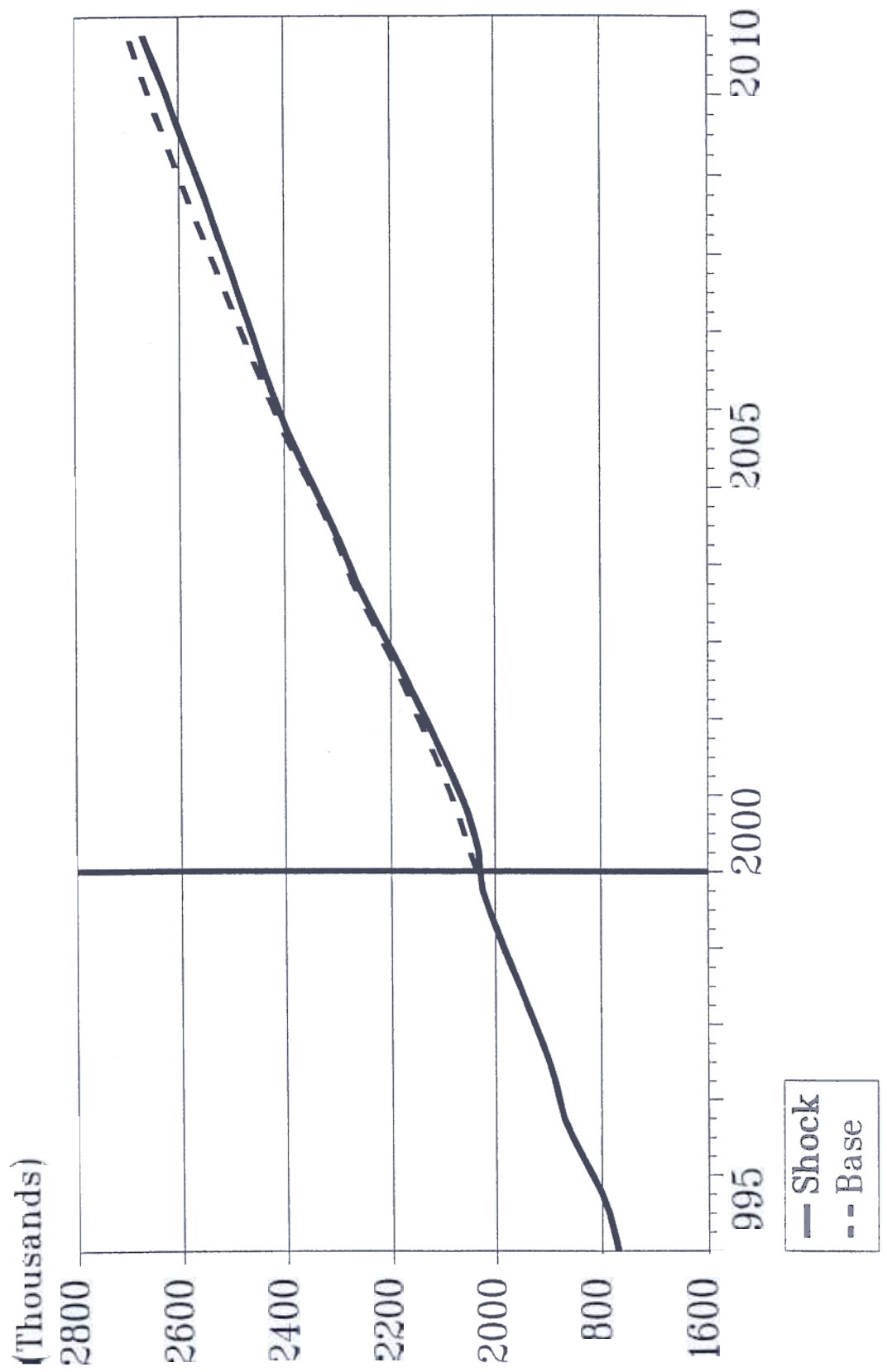
Employment in Trade Reformulate Gas Case Shock Vs Base



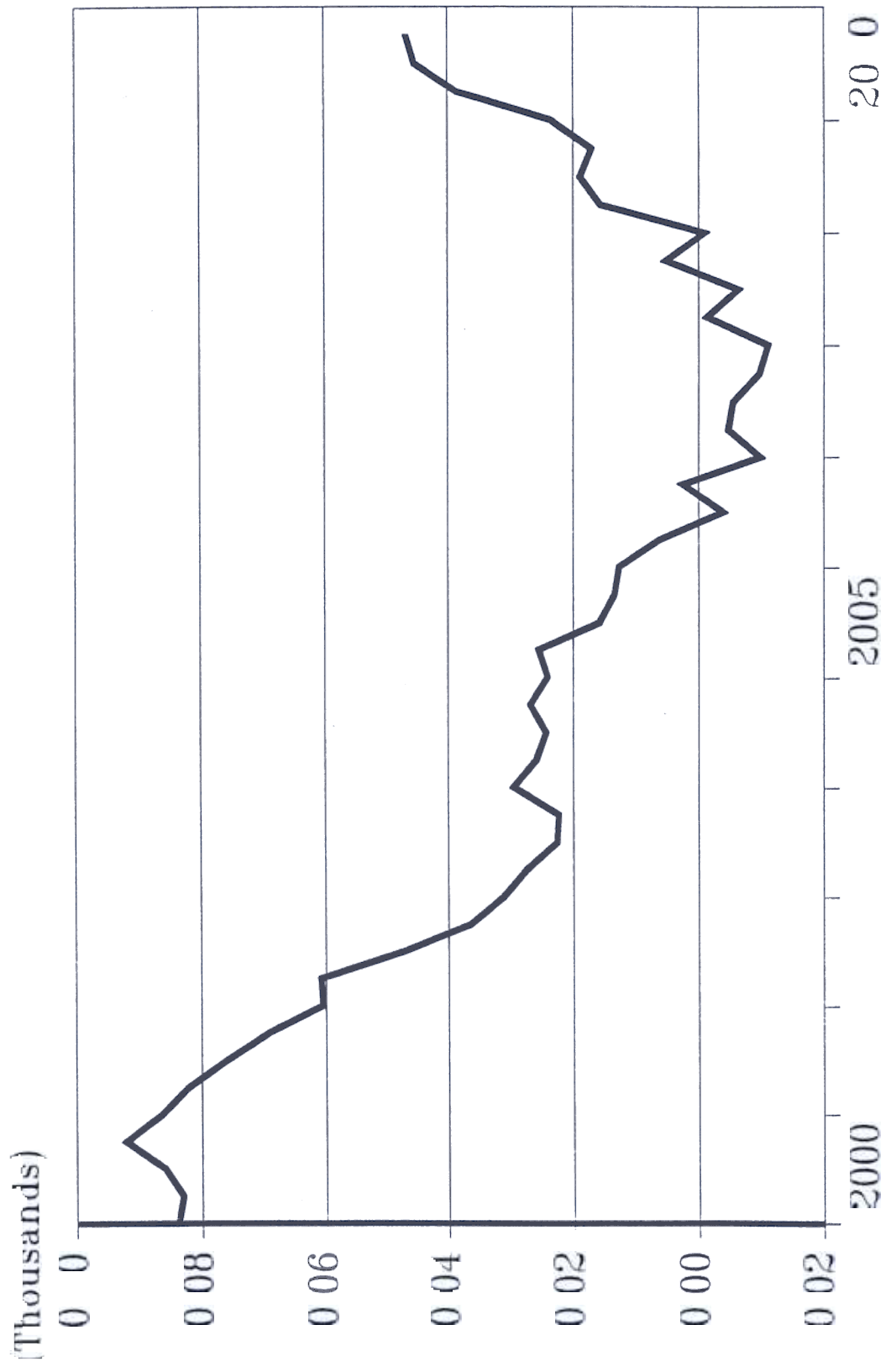
Employment in Construction Reformulate Gas Case Shock Vs Base



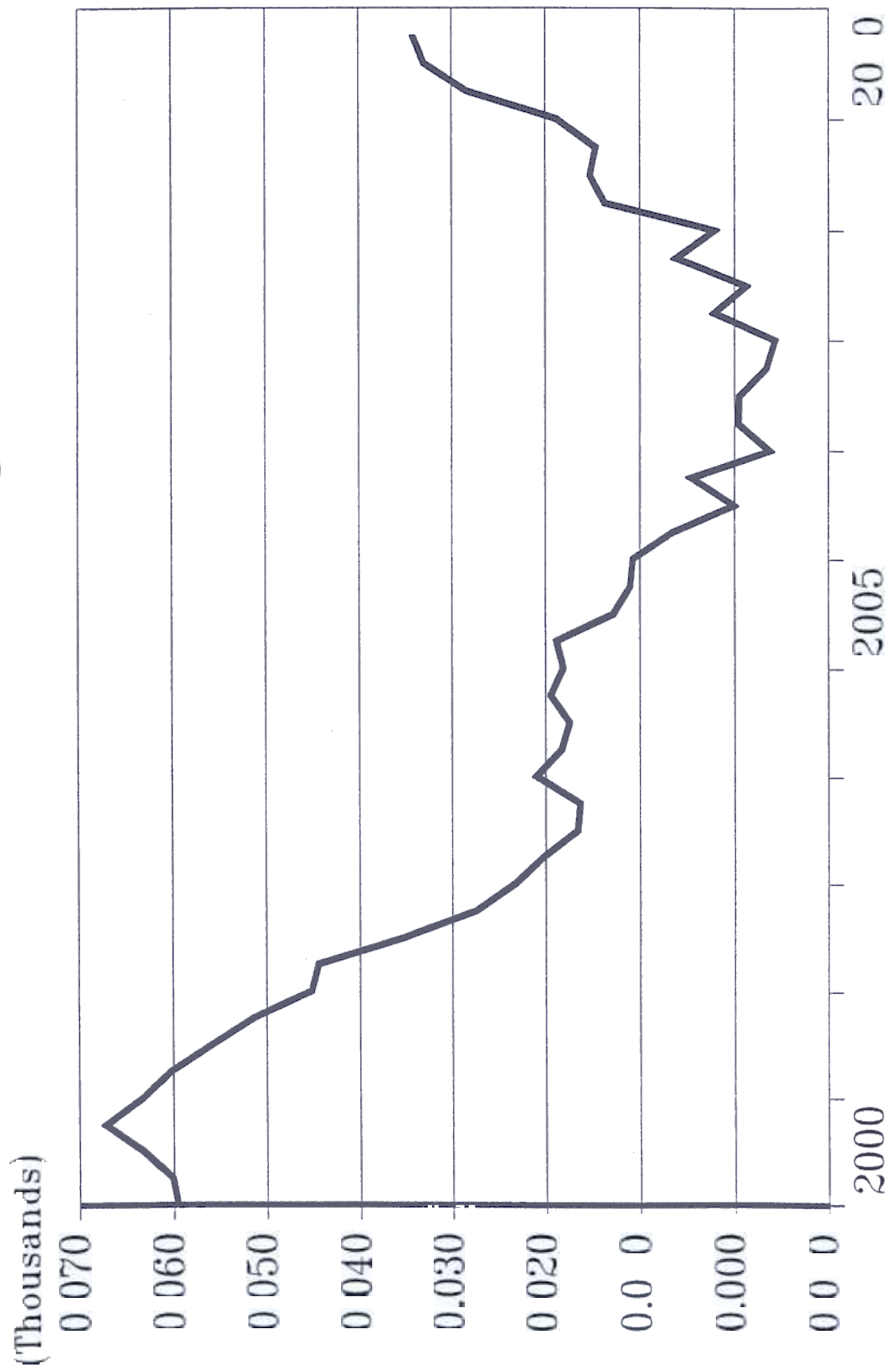
Employment in State and Local Government Reformulate Gas Case Shock Vs Base



Employment in Manufacturing Reform and Shock Minus Regular Gas Shock



Employment in Manufacturing Durables Reformulate Shock Minus Regular Gas Shock



Employment in Manufacturing Non Durables Reformulate Shock Minus Regular Gas Shock

(Thousands)

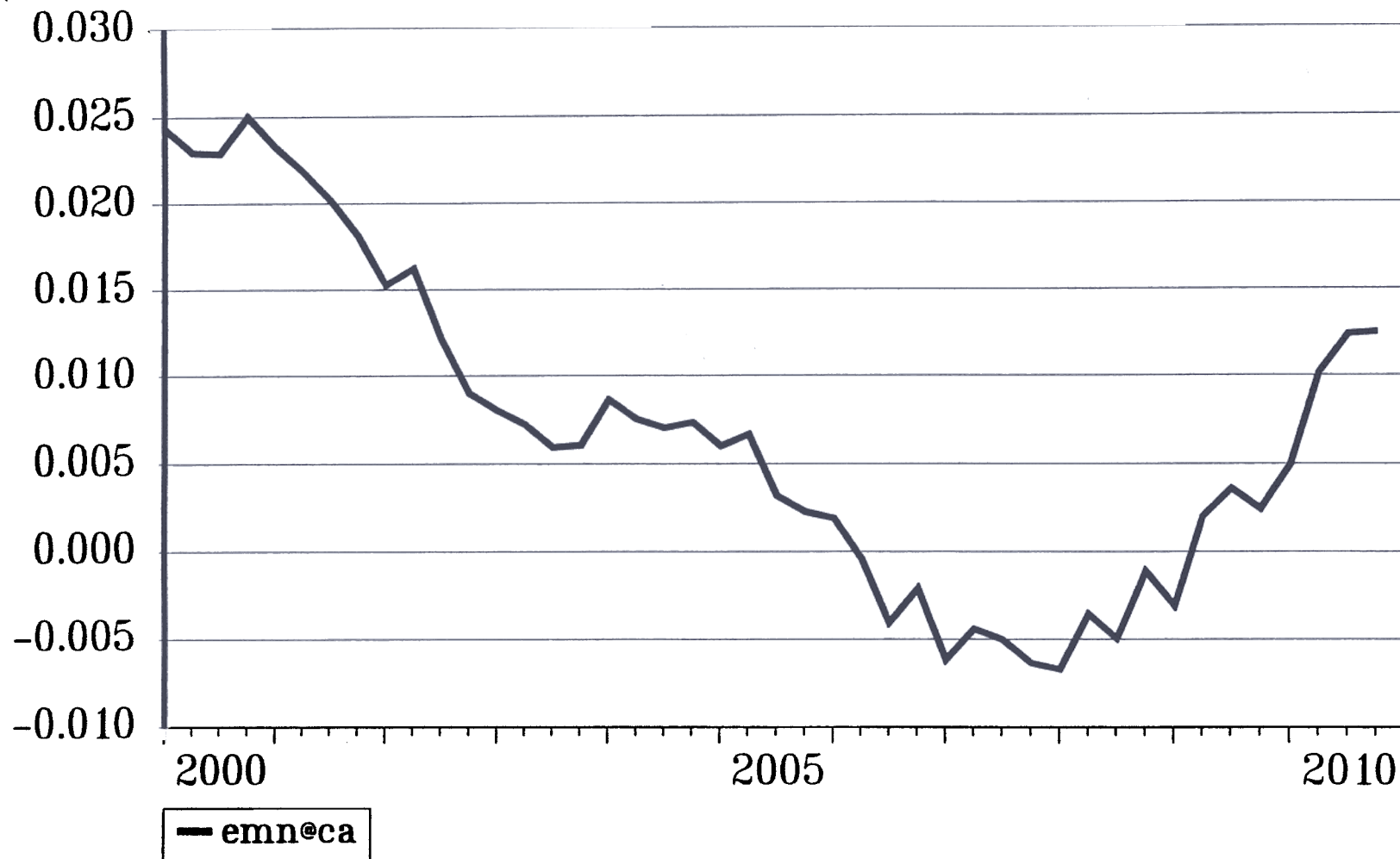
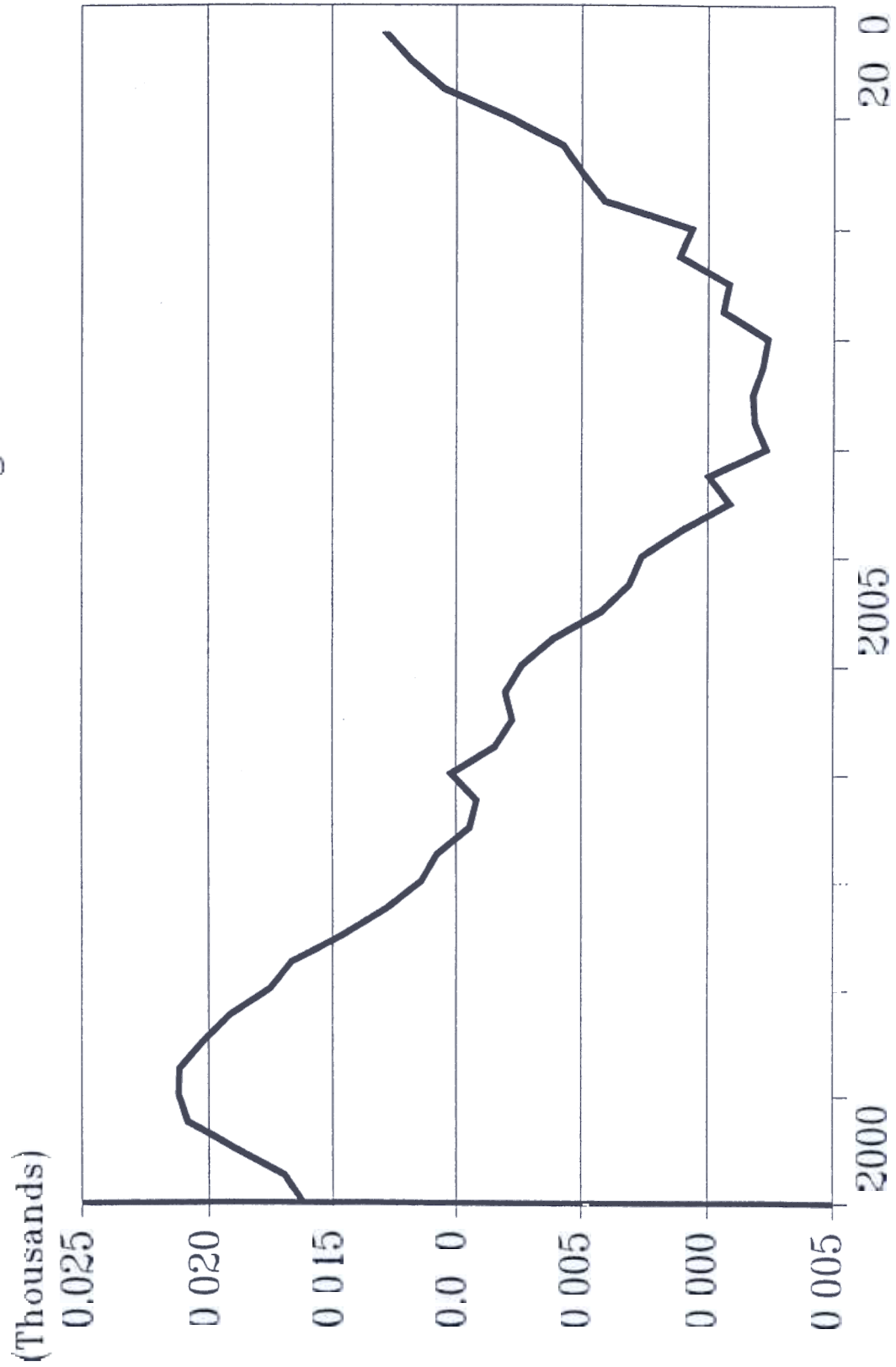
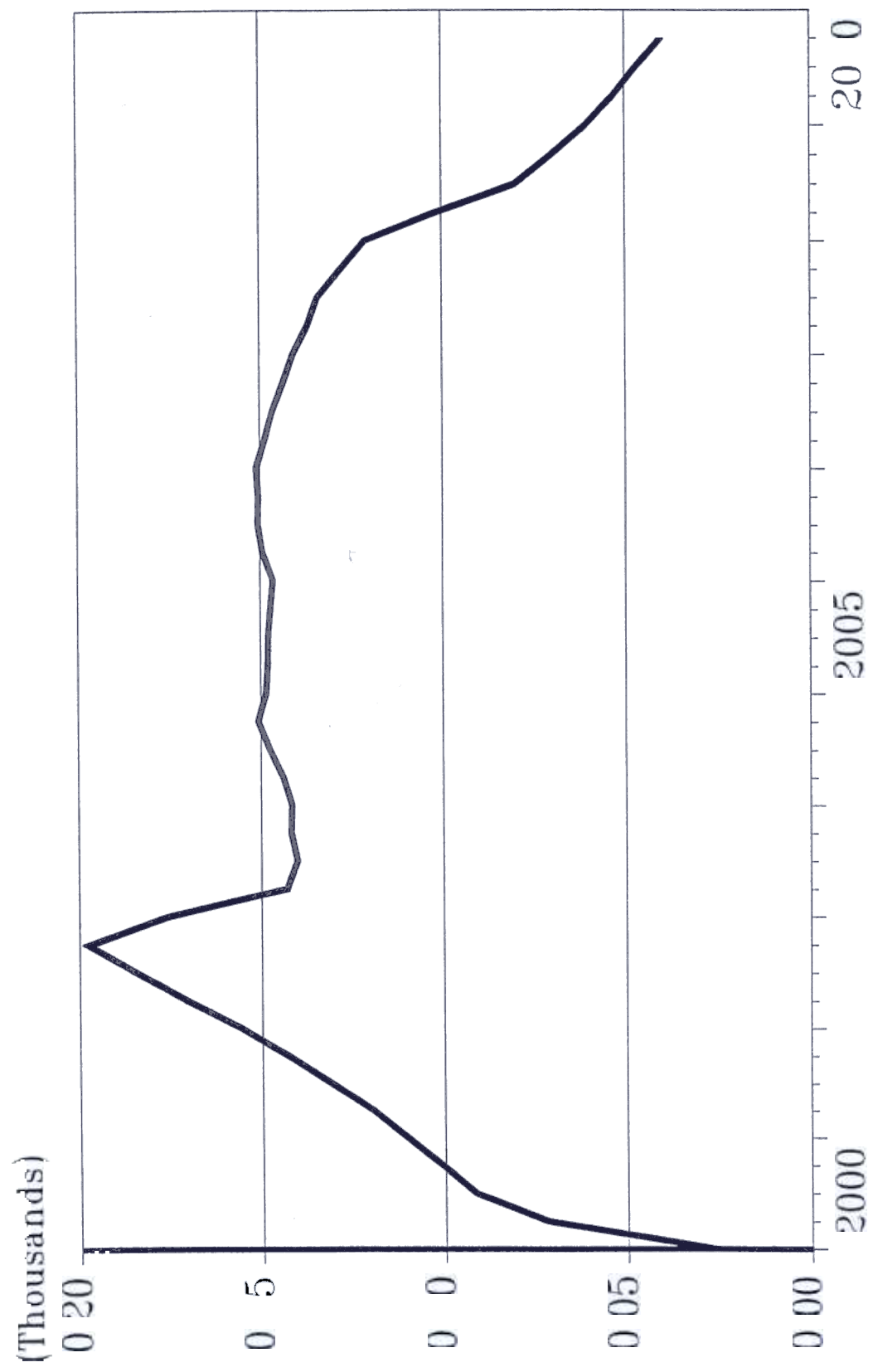


Chart 30.

Employment in Aerospace Manufacturing Reformulate Shock Minus Regular Gas Shock

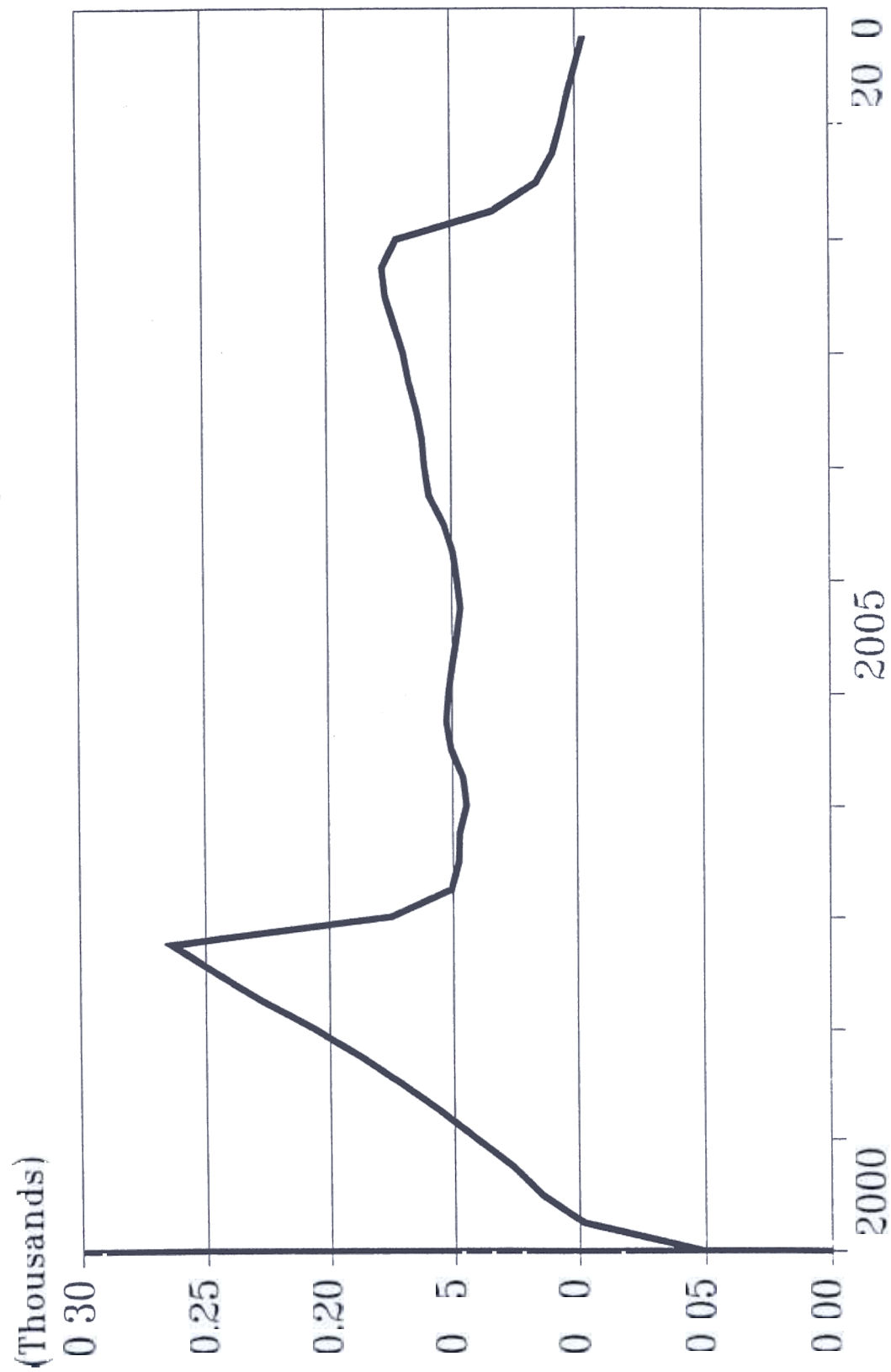


Employment in Finance Reformulate Shock minus Regular Gas Shock

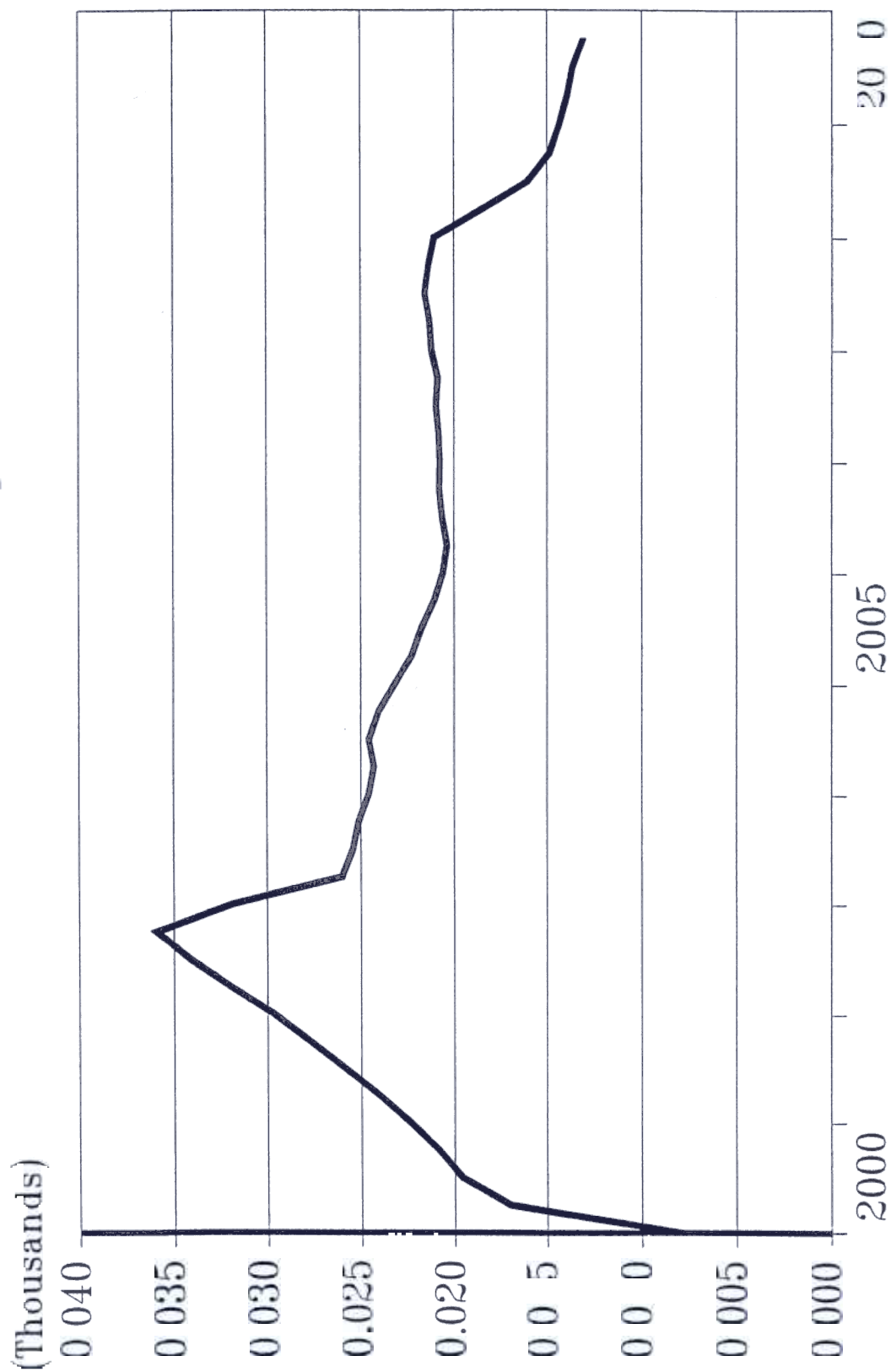


Chart

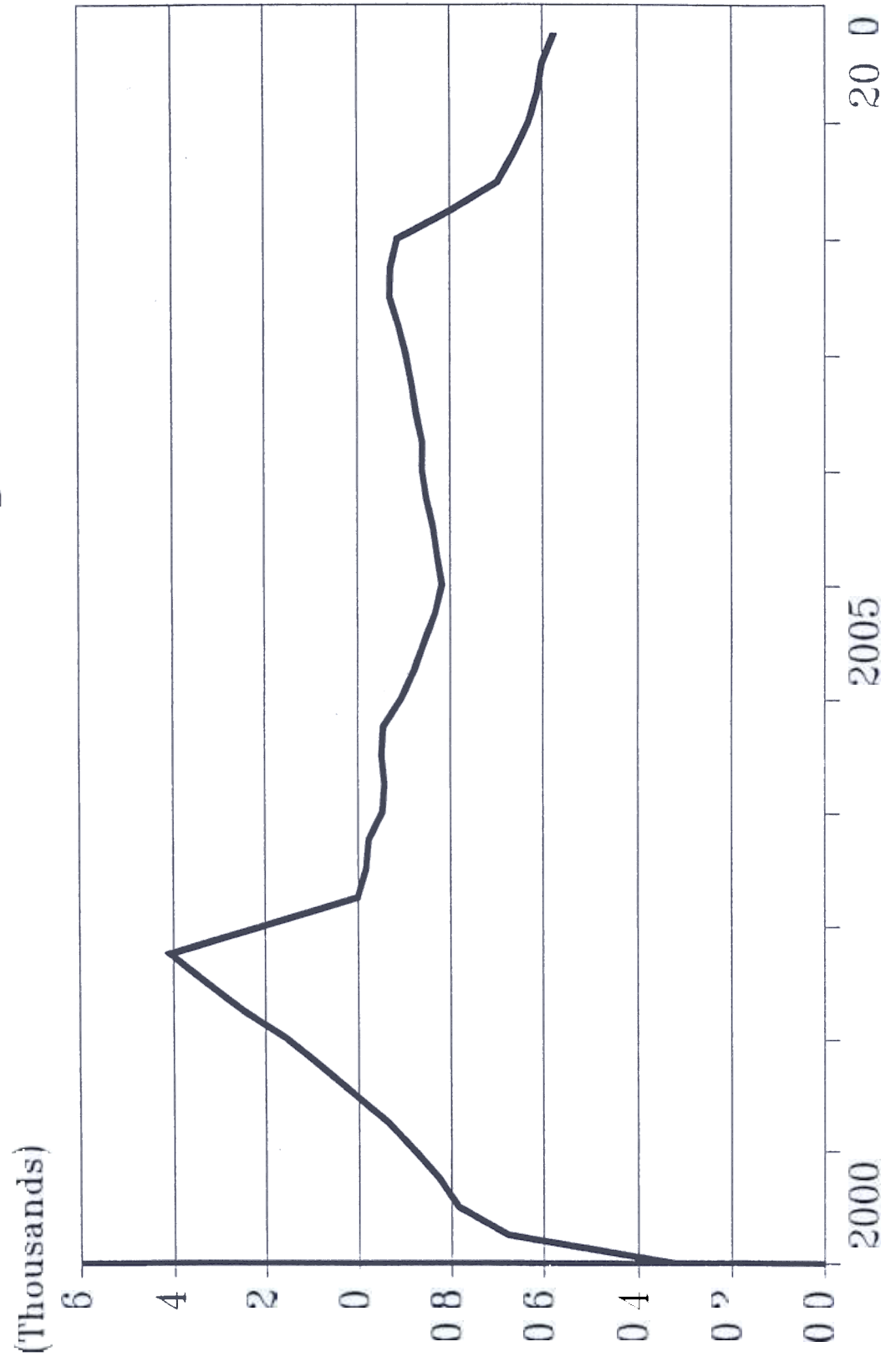
Employment in Business Services Reformulate Shock Minus Regular Gas Shock



Employment in Motion Pictures Reformulate Shock Minus Regular Gas Shock



Employment in Services
 Reformulate Shock Minus Regular Gas Shock



Employment in Trade

Reformulate Shock Minus Regular Gas Shock

(Thousands)

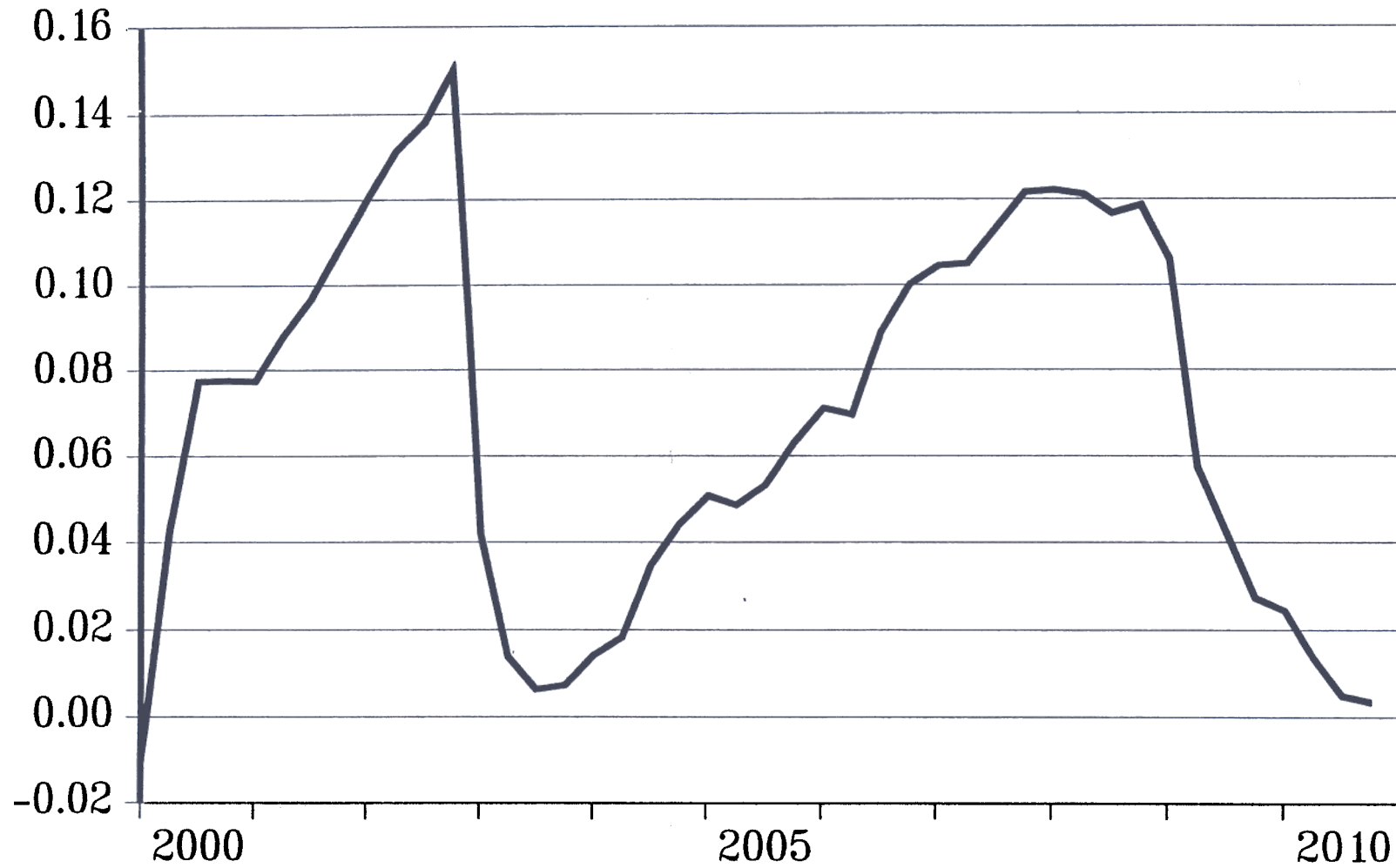
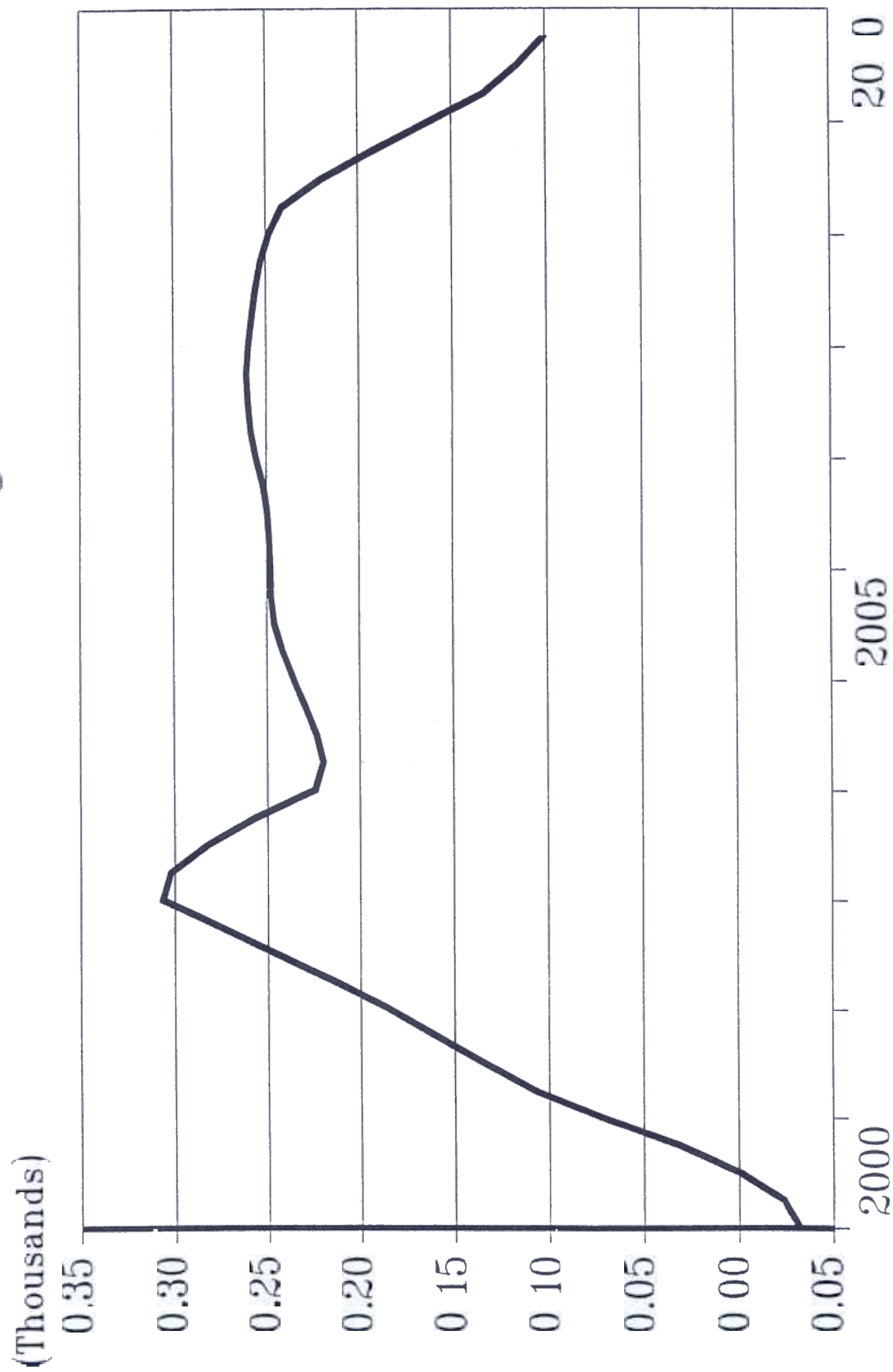


Chart 36.

Employment in Construct on Reformulate Shock Minus Regular Gas Shock



Chart