

Koskela, Erkki; Virén, Matti

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## Government size and economic growth: some evidence from a market price approach

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Erkki Koskela\* and Matti Virén\*\*  
Bank of Finland Research Department  
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GOVERNMENT SIZE AND ECONOMIC GROWTH:  
SOME EVIDENCE FROM A MARKET PRICE APPROACH\*\*\*

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\* University of Helsinki, Aleksanterinkatu 7,  
SF-00101 Helsinki

\*\* Bank of Finland, Research Department, Box 160,  
SF-00101 Helsinki.

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## ABSTRACT

This paper presents a simple model of aggregate demand in current market prices, in which public sector employment affects aggregate (and private) demand via the total output, the lump-sum taxes and the valuation of public sector production. While the last effect is positive for aggregate demand, the other two effects are ambiguous a priori so that the total effect remains indeterminate. On the other hand, the relationship between public sector employment and private output (and demand) is quite likely sensitive to and might depend inversely on the size of the public sector. Empirical results using data from 19 OECD countries over the period 1960 - 1987 indicate that there is practically no within-country relationship between public sector employment and private sector output over time, while there seems to be some, though weak, evidence in favour of the hypothesis that the effect of the public sector employment on private sector output depends inversely on the size of the public sector across countries.



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## 1 INTRODUCTION

Recently, there has been numerous, though conflicting, empirical studies which have tried to isolate the potential effect of the government size either on the total output or on the output growth (see e.g. Barro (1989), Diamond (1989), Landau (1983), Ram (1986), Rubinson (1977), Singh & Sahni (1984), (1986)). Typically, the total output (or the output growth) in these studies has been explained by government output, total investment, labour input and a bundle of other variables (or by the growth of the respective variables).<sup>1</sup>

Common to empirical research in this area has been to use the standard national accounts data. But, as has been pointed out by Carr (1989), the standard methodology for valuing government expenditures in a national income accounting framework may easily bias the researcher towards accepting the null hypothesis that increased government size will give rise to increased economic growth. This is basically because the national accounts data implicitly presumes that government output is produced with a constant returns to scale technology, that the whole government output can be classified as the final product and that the market value of the government output is equal to the national accounts value of the government output, evaluated at its cost of production.

Some of those controversial assumptions have been relaxed in earlier studies. The assumption of the linear technology in government output has been dealt in the seminal paper by Baumol (1967) and a number of subsequent studies (see e.g. Skolka (1977), Smith (1975), (1978), Spann (1977)). The possibility that governmentally purchased commodities are public goods, which enhance private productive capital has been considered by Grossman and Lucas (1974), while Aschauer (1989a), (1989b) has analyzed the effect of public capital expenditure on private investment and the rate of return on private capital. Reich (1986), in turn, has produced some empirical evidence on the role of government output as an intermediate product in private production. Finally, Kormendi (1983) has touched upon the valuation problem of government goods by defining the concept of "government dissipation" simply as the difference between the resource cost of government output and the corresponding market value.<sup>2</sup>



The purpose of this paper is also to deal with the question of how the size of the public sector affects the relationship between the public sector employment and the total output by not using the usual, SNA type, concept of output, but the total output in market values. We proceed by first presenting a simple model of aggregate demand expressed in current market prices in section 2. In this model public sector employment affects aggregate demand via three channels: (i) the total output effect, (ii) the tax rate effect and (iii) the valuation effect of public sector production. On the basis of this analysis we then carry out a couple of tests concerning the relationship between public sector employment and private output and explore how it relates to the size of the public sector measured in two slightly different ways in section 3. Finally, there is a brief concluding section.

## 2 A SIMPLE MODEL OF PUBLIC SECTOR EMPLOYMENT, TOTAL OUTPUT AND AGGREGATE DEMAND

This section presents a simple theoretical analysis, which describes the relationship between public sector employment and private output (and demand). The idea is to modify and extend the standard (keynesian-type) models in three ways. First, we account for the possibility that public sector employment affects private production and marginal product of private labour. Second, we allow for the valuation of government sector goods and services in the sense that their (unobservable) relative market price depends inversely on their size. Finally, and in the spirit of the so-called equilibrium approach to fiscal policy, we abstract from the financing issues of government goods and services.

These ideas are captured by the following simple, aggregative model, which determines the total physical output, the employment, the real wage, the (average, lump-sum) tax rate and the aggregate demand expressed in constant market prices. The model is presented in equations (1) - (4).

$$(1) \quad y = F(l_p, l_g) + G(l_g)$$

$$(2) \quad l_p + l_g = N(w/p)$$

$$(3) \quad w/p = F_1(l_p, l_g)$$

$$(4) \quad y^d = D(y(1-\tau)) + zG(l_g)$$

where  $y$  denotes the total physical output of goods and services,  $F$  the private sector production function,  $G$  the public sector production function,  $l_p$  and  $l_g$  the corresponding labour inputs,  $N$  the aggregate labour supply schedule,  $F_1 = \partial F(\cdot)/\partial l_p$  the marginal product of labour in private sector,  $D$  the aggregate demand for private goods and services,  $y(1-\tau)$  the private disposable real income with the (average) lump-sum taxes being  $\tau$ , and finally  $z$  denotes the (unobservable) relative market price of public sector goods and services.

According to (1) private sector output is affected by both private and public sector employment and the production function is assumed to be strictly concave with non-negative cross partial derivatives  $F_{12} = \partial^2 F(\cdot)/\partial l_p \partial l_g = F_{21} = \partial^2 F(\cdot)/\partial l_g \partial l_p > 0$ . For simplicity, capital input is disregarded so that we get rid of capital depreciation as well (the effects of government capital stock is studied in Aschauer (1989a), (1989b)).

Public sector output is assumed to depend only on public sector employment with the positive, but decreasing marginal product so that  $G' = \partial G(l_g)/\partial l_g > 0$  and  $G'' = \partial^2 G(l_g)/\partial l_g^2 < 0$ . The aggregate labour supply is assumed to be a nonnegative function of the real wage  $w/p$  so that  $N' = \partial N(w/p)/\partial (w/p) > 0$ . Like in models of unbalanced growth, we assume that wages are equal in the two sectors so that the equation (2) is the labour market clearing equation (see Baumol (1967)). The equation (3) indicates the private sector labour demand equation. Finally, the equation (4) describes aggregate real demand expressed in constant market prices (multiplying both sides by the price index one obtains the corresponding current market value concept). The real disposable income in (4) is defined by

$(pF + pzG - wl_g)/((pF + pzG)/y) = y(1 - [(w/p)l_g/(F + zG)]) = y(1 - \tau)$   
 where

$$(5) \quad \tau = (w/p)l_g/(F + zG)$$

According to (5) the lump-sum tax rate  $\tau$  - which is assumed to have no income effect on labour supply - is equal to the average public sector resource (wage) costs so that public sector deficits are ruled out.<sup>3</sup> It is assumed that  $0 < D' = \partial D(\cdot)/\partial [y(1-\tau)] < 1$ . The price index  $p$  is in a sense the implicit price deflator of the total output. As for the relative price index of government output,  $z$ , we assume that  $z = z(G(\cdot))$  with  $z' = \partial z(\cdot)/\partial G(\cdot) < 0$  so the higher the government output, the lower its relative valuation, ceteris paribus.<sup>4</sup> What is remaining is the public sector employment which is assumed to be exogenously given.

Using this model we turn to explore how a change in public sector employment effects via various channels aggregate real demand in constant market prices, which is not observable in the standard SNA framework. The various channels of influence can be decomposed as follows

$$(6) \quad dy^d/dl_g = D' \{ (1-\tau)(dy/dl_g) - y(d\tau/dl_g) \} + G'MB(G),$$

where

$$(7) \quad \begin{aligned} (i) \quad dl_p/dl_g &= -(1-N'F_{12})(1-N'F_{11})^{-1} \\ (ii) \quad dy/dl_g &= F_2 + G' + F_1(dl_p/dl_g) \\ (iii) \quad d\tau/dl_g &= (F + zG)^{-1} \{ [(w/p) - \tau(F_2 + G'MB(G))] - \\ &\quad \tau F_1(dl_p/dl_g) + l_g[d(w/p)/dl_g] \} \\ (iv) \quad d(w/p)/dl_g &= F_{12} + F_{11}(dl_p/dl_g), \end{aligned}$$

and where  $MB(G) = z(G) + z'(G)G$  describes the marginal valuation of government sector goods and services which we assume to be decreasing, i.e.  $MB'(g) = 2z'(g) + z''(g)g < 0$ . The corresponding private demand effect of a change in public sector employment which is observable in the standard SNA framework is  $dD(\cdot)/dl_g = dy^d(\cdot)/dl_g - G'MB(G)$ .

The expression (7i) describes the equilibrium relationship between the changes in private and public sector employment. Its denominator is positive so that its sign depends the sign of the numerator  $-(1 - N'F_{12})$ . While it is ambiguous a priori, it is plausible that it is negative. In particular, a "small" sensitivity of labour supply with respect to the real wage and a "small" complementarity between the private and public sector employment in the production of private output will give rise to the negative numerator in (7i). In what follows we stick to that assumption so that under these circumstances an exogenous rise in the public sector employment will - by increasing the real wage - "crowd out" the private demand for labour, which depends negatively on the real wage, and vice versa, if the public sector employment falls. In this latter case the private demand for labour is "crowded in".

According to the expression (6) the public sector employment affects the (unobservable) aggregate real demand in constant market prices via three channels: A change in the public sector employment will have (I) the "output effect" (the term  $D'(1-\tau)(dy/dl_g)$ ), (II) the "tax effect" (the term  $-D'y(d\tau/dl_g)$ ) and (III) the "valuation effect" of government sector goods and services produced by a change in government sector employment (the term  $G'MB(G)$ ). While the "valuation effect" is clearly positive, there are conflicting tendencies in the expressions (7ii) and (7iii) for the "output effect" and the "tax effect" respectively so that their signs remain indeterminate a priori.

The reasons for the ambiguities in (7ii) and (7iii) can be explained as follows: First, as for the "output effect", e.g. a rise in public sector employment will directly increase the physical private and public output on the one hand (the term  $F_2 + G' > 0$  in (7ii)), while on the other hand, the private employment will be "crowded out" due to

a rise of the real wage, which has the effect of indirectly decreasing the private output (the term  $F_1(dl_p/dl_g)$  in (7ii)). Thus the "output effect" depends on the relative size of the direct and indirect effect.<sup>5</sup> Second, as for the "tax effect", the (average lump-sum) tax rate  $\tau$  will likely change because of the balanced budget regime (5). But there are some conflicting forces in operation. On the one hand, a rise in public sector employment  $l_g$  will have a direct ambiguous effect on  $\tau$ , because it increases both the numerator and denominator of the expression (5) (the term  $(F + zG)^{-1}[(w/p) - \tau(F_2 + G'MB(G))]$  in (7iii)). On the other hand, the denominator decreases due to a fall in private sector employment, which tends to increase taxes (the term  $(F + zG)^{-1}[-\tau F_1(dl_p/dl_g)] > 0$  in (7iii)). And finally, taxes also increase due to a rise in the common real wage (the term  $l_g(d(w/p)/dl_g) > 0$  in (7iii)). Hence, the "tax effect" remains ambiguous a priori, while it is very likely that  $d\tau/dl_g$  is positive so that the "tax effect" is very likely negative in the expression (6), which describes the equilibrium relationship between the aggregate real demand (in constant market prices) and the public sector employment.

Although the equilibrium relationship between the aggregate real demand (in constant prices) and the public sector employment is a priori ambiguous, one may ask: What happens to this relationship, when the public sector employment gets larger and larger? Since the valuation of government sector goods and services is positive, but decreasing, the marginal valuation of government sector goods and services gets lower, when the public sector employment gets higher, ceteris paribus. If also the private marginal product of public sector employment becomes smaller when public sector employment gets higher, then  $F_2$  tends to be small when the public sector employment is high, ceteris paribus. What this implies for the relationship between  $dy^d$  and  $dl_g$  can be seen by looking at the expressions (6) and (7i - iv): the "valuation effect" gets smaller, the "output effect" and the "tax effect" are more likely negative. And analogous considerations suggest that in an economy with low public sector employment, the relationship between  $dy^d$  and  $dl_g$  is more likely positive. What is the relationship between changes in  $l_g$  and changes in the size of the public sector

measured by  $l_g/(l_p + l_g)$ ? Differentiating this expression with respect to  $l_g$  gives

$$(8) \quad d[l_g/(l_p + l_g)]/dl_g = (l_p + l_g)^{-1} \{1 - (l_g/(l_p + l_g))(1 + (dl_p/dl_g))\}$$

which is positive under the earlier made assumptions. Hence, a change in public sector employment is positively related to change in the size of the public sector measured by  $l_g/(l_p + l_g)$ . Thus, we hypothesize that the relationship between the public sector employment and the aggregate real demand (in constant prices) depend inversely on the size of the public sector; more specifically, public sector employment and the aggregate real demand tend to be positively related in countries with a "small" public sector, while negatively related, when the public sector is already very large! Next we turn to look at how these hypotheses could be empirically evaluated.

### 3 SOME PRELIMINARY EMPIRICAL EVIDENCE

Unfortunately we cannot evaluate the hypotheses directly due to the lack of data on aggregate real demand and output in market value prices. Fortunately, however, there exists data on private sector output and these data can be used to get some rough estimate of the sign and magnitude of the effect of an increase in government size.

As pointed out, our test has to be based on two observable variables: public sector employment and private sector output (or private sector demand). We used the data from 19 OECD countries. Predominantly the data cover the period 1960 - 1987 with some minor exceptions.<sup>6</sup> The following exercises were carried out with these data: (1) coefficients of correlation were computed between  $\Delta \log l_g$  and  $\Delta \log D$ , (2) a simple VAR model was estimated in terms of  $\Delta \log D$ ; the explanatory variables were  $\Delta \log D_{-1}$  and  $\Delta \log l_{g,-1}$  and finally, (3) the Spearman rank correlation coefficients were computed between the government size variable and the correlation coefficient, on the one hand, and between the government size variable and the t-ratios for  $\Delta \log l_{g,-1}$  from the

simple VAR model, on the other hand. In order to check the robustness of results a bit, we used the values of public consumption relative to GDP at current SNA prices, or alternatively the values of public sector production - both denoted by  $G/Y$  - and the share of public sector employment from total employment - denoted by  $l_g/(l_p + l_g)$  - as alternative measures of the size of the public sector.

The results from the above-mentioned exercises (1) - (3) are presented in Table 1. The following features of results merit attention: First, the coefficients of correlation are generally positive, but only one of them is significantly different from zero. Second, a similar type of result applies to the t-ratios from a simple VAR model; approximately half of them are positive, but not a single one exceeds the 5 per cent significance level. On the basis of these results, one is tempted to conclude that the within-country relationship between the public sector employment and the private sector output variables over time is very weak at its best. Finally, an interesting question is whether the size of the public sector - measured alternatively in terms of  $G/Y$  and  $l_g/(l_p + l_g)$  - matters for the relationship across countries? The Spearman rank correlation coefficients tend to give some, though rather weak, evidence in favour of the inverse relationship between the size of the public sector and the effects of public sector employment on the private sector output; the Spearman rank correlation coefficients are negative in all except one case, while mostly rather low. In fact, the five percent critical value is exceeded in only two cases. From that point of view, however, the data set may not be very informative mainly because the OECD countries are fairly similar in terms of the size of the public sector. Unfortunately there is very little if any data from other countries concerning public sector employment.

TABLE 1 Evidence on Relationship between Public Sector Employment and Private Sector Output

Country	G/Y	$l_g/(l_p+l_g)$	Correlation between $\Delta \log D$ and $\Delta \log l_g$	t-ratio for $\Delta \log l_{g,-1}$	G/Y	$l_g/(l_p+l_g)$	Correlation between $\Delta \log D$ and $\Delta \log l_g$	t-ratio for $\Delta \log l_{g,-1}$
Australia	0.163	0.256	0.176	0.348	0.100	0.256	0.196	0.533
Austria	0.166	0.172	0.300	-0.007	0.122	0.172	0.333	0.063
Belgium	0.152	0.160	0.168	0.108	0.122	0.160	0.207	0.006
Canada	0.182	0.183	-0.257	-0.118	0.148	0.183	-0.315	-0.438
Denmark	0.233	0.247	-0.211	-0.319	0.210	0.238	-0.167	-0.192
Finland	0.163	0.142	0.021	0.768	0.120	0.142	-0.002	0.637
France	0.165	0.138	-0.240	-1.091	0.147	0.138	-0.275	-1.036
Germany	0.177	0.129	0.221	0.164	0.102	0.129	0.291	0.325
Italy	0.139	0.125	0.141	0.241	0.105	0.129	0.055	-0.078
Japan	0.094	0.064	0.040	-0.110	0.081	0.064	0.047	-0.213
Netherlands	0.159	0.137	0.114	0.256	0.129	0.144	0.257	0.081
New Zealand	0.131	0.177	-0.045	0.505				
Norway	0.178	0.192	0.069	-0.148	0.135	0.203	0.070	-1.045
Portugal	0.136	0.086	0.150	0.530	0.081	0.074	0.119	0.536
Spain	0.109	0.102	0.098	0.221	0.088	0.102	0.104	0.327
Sweden	0.231	0.243	0.261	-0.117	0.177	0.251	0.256	-0.088
Switzerland	0.111	0.079	0.706	0.379				
United Kingdom	0.192	0.193	0.003	1.144	0.120	0.196	0.252	1.127
USA	0.179	0.172	0.144	-0.210	0.122	0.172	0.192	-0.180
Spearman rank correlation coefficient for G/Y:								
			-0.161 (25.8)	-0.434 (2.0)				
for $l_g/(l_p + l_g)$ .			-0.193 (21.6)	-0.219 (17.0)	-0.161 (26.5)	0.136 (69.5)	-0.573 (0.4)	-0.140 (28.6)

The numbers inside parentheses are marginal (percentage) significance levels. The first four columns correspond to the public consumption data, while the other four columns correspond to the public sector (i.e. producers of public sector services) production data.



#### 4 A BRIEF CONCLUSION

This paper has presented a simple model of aggregate demand in current market prices, in which public sector employment affects aggregate (and private) demand via the total output, the lump-sum taxes and the valuation of the public sector goods and services. While the last effect is positive for the aggregate demand, the other two effects are ambiguous a priori so that the total effect remains indeterminate. On the other hand with a positive, but decreasing marginal valuation of government production and with a positive, but decreasing marginal private productivity of  $l_g$  it is likely that the relationship between the public sector employment and the aggregate real demand is inverse; it tends to be positive (negative) with a "small" ("large") public sector measured by  $l_g/(l_p + l_g)$ .

Empirical results using data from 19 OECD countries over the period 1960 - 1987 indicate that there is practically no within-country relationship between public sector employment and private sector output over time, while there seems to be some weak evidence in favour of the hypothesis that the effect of the public sector employment on the private sector output depends inversely on the size of the public sector across countries.

## FOOTNOTES

- 1 There exists an even larger literature, which deals with a "reverse causation" issue; what explains the size (and structure) of government sector over time and across countries? For a collection of some recent empirical research in this field, see Lybeck and Henrekson (1988).
- 2 It should be noticed that the System of National Accounts data are also used e.g. in testing for the hypothesis that there is a direct substitution between the public and private consumption. See e.g. Aschauer (1985) and Olekalns (1989) for details.
- 3 This is compatible with the so-called equilibrium approach to fiscal policy, according to which the lump-sum financial policies are - to a first approximation - irrelevant to private sector outcomes. This hypothesis of an equivalence between tax and debt finance of a particular time sequence of government spending has been subject to a lot of empirical testing with somewhat mixed results (see e.g. Bernheim (1987) on the one hand and Evans (1987) on the other hand).
- 4 Assuming  $z = z(G/Y)$  with  $z' < 0$  would complicate the analysis with no qualitative difference, while the assumptions  $z = 1$  and  $F_2 = G'' = 0$  would lead to the standard framework.
- 5 Hence, the results obtained by using the SNA data, according to which a rise in the size of the public sector leads to increased economic growth should be treated with some suspect, at least. With decreasing marginal productivity of  $l_g$  there might be an inverse relationship between  $y$  and  $l_g$  depending on the size of the public sector.
- 6 Private sector output is measured either by (GDP - public consumption) or by (GDP - public sector production) and public sector employment by the number of employees in the "producers of government services" sector. Data are mainly derived from OECD National Accounts, OECD Paris 1982.

## DATA SOURCES:

- GDP            Gross Domestic Product at current or constant 1980 prices. Data source: OECD National Accounts, Volume II, Detailed Tables, OECD, Paris.
- G              Public consumption or public sector (i.e. producers of government services) production, both at current or constant 1980 prices. Data source: OECD National Accounts, Volume II, Detailed Tables, OECD, Paris.
- l<sub>g</sub>            Public sector employment (thousands of persons). Data source: Employment in the Public Sector, OECD 1982, Paris; OECD National Accounts, Volume II; Detailed Tables, OECD, Paris; and some national sources. The data are listed on the subsequent page.
- l<sub>p</sub>            Private sector employment (thousands of persons). Data source: the same as with L<sub>g</sub>.

YEAR	AUSTRAL	AUSTR	BELGIA	CANADA	DENMARK	FINLAND	FRANCE	GERMANY	ITALY	JAPAN	NETHERL	NEWZEAL	NORWAY	PORTUG	SPAIN	SWEDEN	SWITZERL	ENGL	USA
1960	934	347	431	-	-	164	2391	2136	1751	-	495	152	-	177	-	463	171	3967	11343
1961	961	355	435	-	-	173	2414	2269	1810	-	503	152	-	189	-	479	177	3638	11679
1962	983	364	452	-	-	179	2412	2391	1886	-	511	156	186	160	-	493	182	3703	12022
1963	1008	369	465	-	-	188	2340	2489	1955	-	515	163	193	173	-	529	188	3773	12257
1964	1033	378	477	-	-	196	2321	2586	2016	-	518	168	201	182	833	557	196	3854	12684
1965	1062	382	489	-	-	201	2333	2676	2050	-	522	172	206	196	785	577	203	3942	13096
1966	1120	391	503	1302	303	214	2372	2755	2086	-	534	177	211	210	801	605	208	4073	14256
1967	1158	401	514	1368	326	218	2424	2828	2135	-	543	181	221	225	817	643	214	4230	15078
1968	1195	413	521	1439	348	234	2471	2854	2179	-	550	185	232	242	793	692	222	4323	15541
1969	1228	423	526	1514	371	247	2528	2911	2242	-	564	189	243	261	805	743	234	4363	15825
1970	1262	432	534	1570	393	257	2596	3032	2284	3147	573	193	253	282	875	807	245	4458	15837
1971	1294	452	545	1673	422	267	2667	3149	2398	3228	591	197	265	304	958	861	254	4585	15846
1972	1327	470	560	1708	451	279	2739	3292	2525	3322	608	204	277	314	955	905	264	4744	15916
1973	1361	494	572	1758	484	295	2797	3389	2644	3445	614	203	289	322	1182	938	273	4882	16150
1974	1403	516	587	1822	518	313	2861	3504	2754	3560	624	209	298	326	1186	994	280	4923	16442
1975	1505	541	596	1897	552	328	2917	3576	2848	3646	637	222	308	327	1246	1045	284	5218	16747
1976	1501	560	616	1908	570	349	2969	3635	2947	3680	658	227	320	331	1342	1094	289	5320	16768
1977	1535	582	628	1978	596	361	3031	3660	3049	3723	676	227	333	331	1354	1140	294	5279	16953
1978	1567	595	658	1994	624	376	3078	3746	3096	3798	690	233	348	361	1482	1198	297	5296	17324
1979	1585	605	693	1977	661	389	3124	3844	3161	3858	703	-	359	383	1488	1251	303	5384	17552
1980	1667	622	707	-	691	401	3160	3903	3194	3911	714	-	375	399	1240	1300	-	5349	17929
1981	1697	624	713	-	719	419	3211	3968	3260	3953	728	-	387	404	1294	1332	-	5318	17875
1982	1720	634	717	-	746	433	3285	3996	3303	3977	734	-	393	420	1320	1345	-	5265	17838
1983	1860	646	711	-	753	447	3360	4026	3323	3991	733	-	404	436	1358	1359	-	5290	17945
1984	1877	657	718	-	747	456	3409	4039	3391	4000	730	-	413	443	1401	1398	-	5301	18197
1985	1912	667	728	-	752	468	3516	4089	3439	3943	736	-	423	445	1457	1413	-	5318	18510
1986	1941	681	748	-	758	476	3591	4132	3471	3960	743	-	427	449	1508	1406	-	5347	18742
1987	2011	687	-	-	769	489	3615	4177	3533	3969	744	-	-	-	1574	1388	-	5374	19052

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