

# News Release



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**Economy and Finance**

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## National Accounts

### Seasonally adjusted GDP 2000-2005 Q2

The fluctuations observed in a time series can be classified as repeatable or non-repeatable. Seasonality can be defined as a pattern of a time series, which repeats itself at regular intervals every year due to factors such as the weather or institutional issues. Evaluating whether the economy, or particular aspects of it, is in growth or decline, predicting business cycles, or understanding how far along the business cycle the economy has progressed, is a fundamental task.

Seasonal adjustment is the process by which changes in the pattern of the observed variables that are due to seasonal or calendar influences are removed in order to produce a clearer picture of the underlying behaviour. By providing more interpretable measures of changes occurring in a given time period, seasonally adjusted data reflects the underlying real economic movements without the misleading seasonal changes.

A time series for which the seasonal movements have been eliminated allows the comparison of data between two quarters for which the seasonal pattern is different. Also, seasonal effects on non-adjusted or original data make it difficult to derive valid comparisons over time using these data, particularly for the most recent period. Consequently, it has become common practice to use seasonally adjusted data for economic modelling and cyclical analysis. Presentation of data on a seasonally adjusted basis allows the comparison of the evolution of different series which are characterised by different seasonal patterns; it is particularly pertinent in the context of international comparisons since countries may be affected by different seasons at identical periods of the year. By removing the short term seasonal fluctuations, seasonal adjustments allows the determination of medium/long term movements in the data.

### Theoretical principles and applications

Consider an observed time series which is known to be seasonally affected, where  $t$  runs from 1 to  $n$ . The main purpose of seasonal adjustment is to separate the observed data into two components, a nonseasonal and a seasonal component. These components are not observed, and hence have to be estimated from the data. This notion can be represented by

$$y_t = \hat{y}_t^{NS} + \hat{y}_t^S$$

where  $\hat{y}_t^{NS}$  and  $\hat{y}_t^S$  denote the estimated nonseasonal and seasonal components respectively. This decomposition assumes an additive relation (if the seasonal fluctuations are, for example, multiplicative with the trend, one can consider applying the natural log transformation to ensure additivity).

Broadly speaking there two approaches to estimate the components in the above equation, namely:

1. The Census X-11 method, based on a moving average filtering algorithm, developed by the U.S. Bureau of Census during the 1960s. Although this method is still used in current practice, it has significant drawbacks that have led to a search for new methodologies. Other off-the-shelf programs commonly used worldwide that are basically improved variants of the X-11 method (and consequently, also adopting moving average procedures) include the X-11 ARIMA as well as the latest, and a more complex model, the X-12 ARIMA.

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2. The second approach involves model-based methods, by assuming that the seasonal component can be described by a certain model. One program in common use performs seasonal adjustment by signal extraction, using the TRAMO/SEATS package developed by the Bank of Spain and promoted by Eurostat. This approach is based on optimal filtering which is derived from a time series model of the ARIMA type describing the behaviour of the observed series, whilst the underlying unobserved components are explicitly specified. TRAMO is a pre-program which initially models the series with AR(1) and ARMA(1,1) to determine the periodic and seasonal difference levels. The appropriate seasonal or non-seasonal ARMA model is selected according to an appropriate statistical criterion. TRAMO also automatically identifies outliers and calculates other regression variables such as trading or Easter day variables. Then, TRAMO passes on the linearised series to SEATS, which carries out the actual decomposition; SEATS then estimates the parameters of the two components (trend-cycle and seasonally adjusted component) ■

**The scope of this news release is to continue familiarising users with the concept of seasonal adjustments as applied to the GDP expenditure approach components at current and constant prices. The figures should be interpreted with caution, since the seasonally-adjusted GDP level varies depending on the number of observations and the detail in the GDP components. This release is technical in nature and is therefore primarily intended for econometricians and statisticians. It contains information on the models used and on the resulting diagnostics. The figures in this release are based on the official GDP figures published on the 7th September in news release number 192/2005.**

**Table 1. Original data at current prices**

		Lm'000						
Period		Consumption	Government Expenditure	Gross Capital Formation	Exports	Imports	GDP	% change (Q <sub>t</sub> /Q <sub>t-1</sub> )
2000	Q1	252,834	82,893	87,930	335,428	379,734	<b>379,351</b>	
	Q2	263,098	81,582	123,140	396,469	446,044	<b>418,245</b>	10.25
	Q3	274,420	79,599	94,247	431,898	439,456	<b>440,708</b>	5.37
	Q4	283,008	83,206	121,445	409,028	474,865	<b>421,822</b>	-4.29
2001	Q1	248,726	84,106	97,551	340,784	381,958	<b>389,209</b>	-7.73
	Q2	267,720	89,176	76,860	367,871	372,125	<b>429,502</b>	10.35
	Q3	285,565	85,665	64,059	372,404	358,564	<b>449,129</b>	4.57
	Q4	286,700	97,684	78,110	338,771	374,986	<b>426,279</b>	-5.09
2002	Q1	263,859	92,846	63,949	316,198	331,365	<b>405,487</b>	-4.88
	Q2	272,931	100,442	63,174	388,825	387,858	<b>437,514</b>	7.90
	Q3	286,158	91,662	41,017	412,315	370,002	<b>461,150</b>	5.40
	Q4	272,343	91,532	81,950	375,260	384,383	<b>436,702</b>	-5.30
2003	Q1	265,243	104,806	93,652	315,743	366,872	<b>412,572</b>	-5.53
	Q2	274,649	102,084	94,005	368,458	390,266	<b>448,930</b>	8.81
	Q3	296,051	93,481	69,935	398,233	388,316	<b>469,384</b>	4.56
	Q4	289,785	95,948	88,428	361,381	378,980	<b>456,562</b>	-2.73
2004	Q1	265,195	104,797	74,940	327,480	338,746	<b>433,666</b>	-5.01
	Q2	282,573	103,139	105,473	354,099	391,016	<b>454,268</b>	4.75
	Q3	306,406	99,384	79,859	370,175	375,787	<b>480,037</b>	5.67
	Q4	303,273	104,706	136,298	337,150	418,902	<b>462,525</b>	-3.65
2005	Q1	256,677	97,567	137,895	284,924	338,548	<b>438,515</b>	-5.19
	Q2	281,702	102,421	131,565	339,556	379,112	<b>476,132</b>	8.58

**Table 2. Final seasonally adjusted series at current prices**

		Lm'000						
Period		Consumption	Government Expenditure	Gross Capital Formation	Exports	Imports	GDP	% change (Q <sub>t</sub> /Q <sub>t-1</sub> )
2000	Q1	268,009	81,949	86,142	380,503	420,341	<b>396,263</b>	
	Q2	268,272	81,450	115,173	387,590	426,025	<b>426,460</b>	7.62
	Q3	267,893	82,022	120,400	396,156	438,575	<b>427,896</b>	0.34
	Q4	269,835	83,022	107,732	406,860	453,283	<b>414,166</b>	-3.21
2001	Q1	269,461	84,068	95,565	386,578	422,789	<b>412,881</b>	-0.31
	Q2	272,720	86,123	71,889	359,631	355,443	<b>434,921</b>	5.34
	Q3	274,577	88,260	81,839	341,586	357,890	<b>428,372</b>	-1.51
	Q4	275,335	100,280	69,289	336,979	357,895	<b>423,988</b>	-1.02
2002	Q1	277,951	91,799	62,644	358,689	366,778	<b>424,304</b>	0.07
	Q2	278,410	94,780	59,088	380,114	370,490	<b>441,902</b>	4.15
	Q3	278,414	95,817	52,404	378,190	369,351	<b>435,475</b>	-1.45
	Q4	263,609	96,579	72,696	373,275	366,812	<b>439,347</b>	0.89
2003	Q1	280,635	98,842	91,739	358,174	406,067	<b>423,322</b>	-3.65
	Q2	280,584	98,425	87,921	360,205	372,810	<b>454,326</b>	7.32
	Q3	282,763	98,518	89,352	365,273	387,679	<b>448,226</b>	-1.34
	Q4	283,181	99,260	78,443	359,469	361,602	<b>458,751</b>	2.35
2004	Q1	285,638	101,166	73,410	371,488	374,924	<b>456,777</b>	-0.43
	Q2	286,156	101,270	98,647	346,169	373,546	<b>458,696</b>	0.42
	Q3	287,115	102,569	102,033	339,536	375,219	<b>456,035</b>	-0.58
	Q4	289,180	102,479	120,907	335,366	399,631	<b>448,301</b>	-1.70
2005	Q1	288,660	99,932	135,077	323,214	374,691	<b>472,192</b>	5.33
	Q2	291,659	99,303	123,050	331,951	362,192	<b>483,772</b>	2.45

**Table 3. Information on models at current prices**

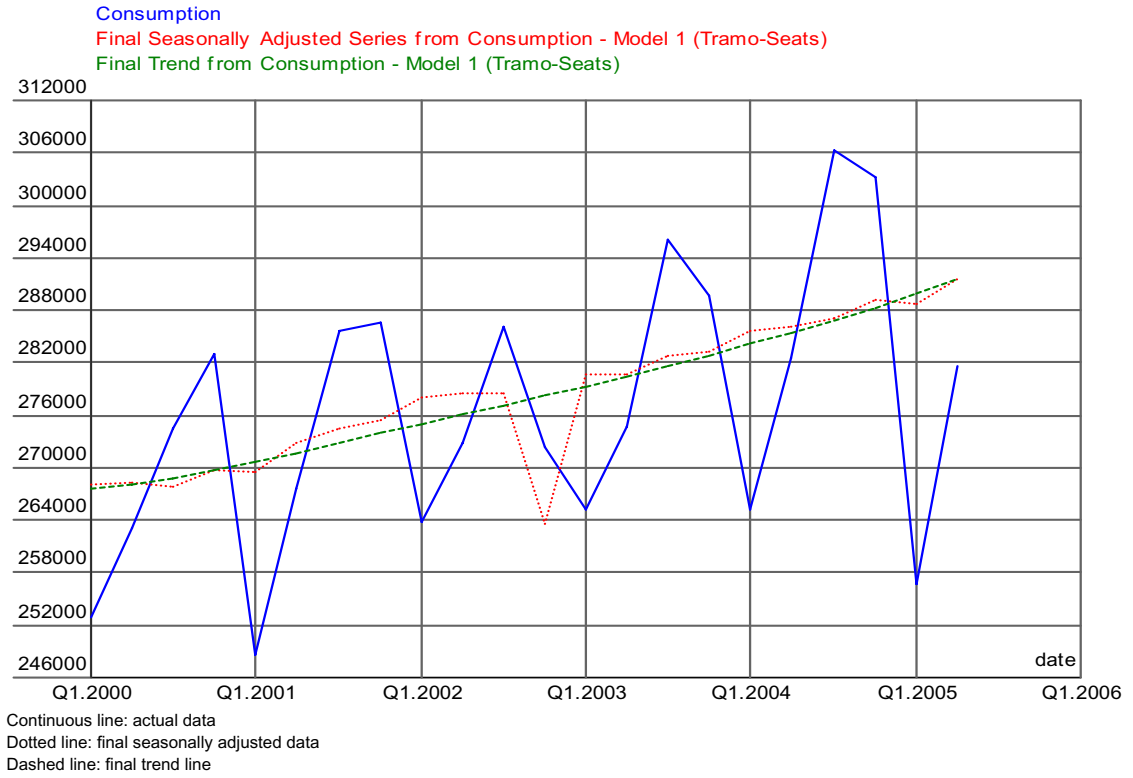
Variable	Status of adjustment	Time span (n° of obs.)	Arima model	Transformation	Mean correction	Outliers	ARIMA decomposition	Seasonality
Consumption	Accepted	Q1.2000 - Q2.2005 (22)	(3 1 1)(0 1 1)	Logarithm	None	Autom.(t-value>2.800):AO,LS,TC; 1: AO Q4.2002,	Exact	Seasonal model used
Government Expenditure	Accepted	Q1.2000 - Q2.2005 (22)	(0 1 1)(0 1 1)	Logarithm	None	Autom.(t-value>2.800):AO,LS,TC; 1: AO Q4.2001,	Approximated	Seasonal model used
Gross Capital Formation	Accepted	Q1.2000 - Q2.2005 (22)	(0 1 1)(0 1 1)	Logarithm	None	Autom.(t-value>2.800):AO,LS,TC	Exact	Seasonal model used
Exports	Accepted	Q1.2000 - Q2.2005 (22)	(0 1 1)(0 1 1)	Logarithm	None	Autom.(t-value>2.800):AO,LS,TC	Exact	Seasonal model used
Imports	Accepted	Q1.2000 - Q2.2005 (22)	(3 1 1)(0 1 1)	Logarithm	Yes	Autom.(t-value>2.800):AO,LS,TC; 2: TC Q2.2001, AO Q1.2003,	Exact	Seasonal model used

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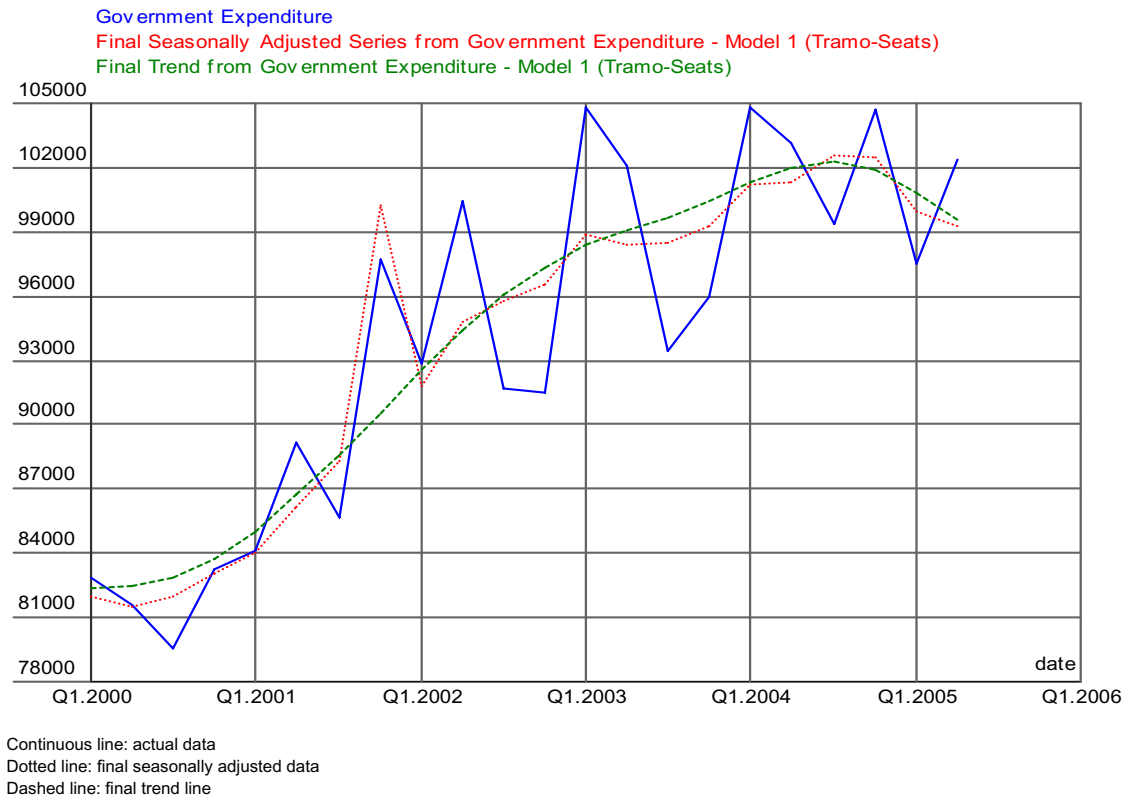
**Table 4. Information on diagnostics at current prices**

Variable	Ljung-Box on residuals	Ljung-Box on squared residuals	Box-Pierce on residuals	Box-Pierce on squared residuals	Normality	Skewness	Kurtosis	Percentage of outliers
Consumption	2.64 [0, 14.10] 5%	4.96 [0, 14.10] 5%	0.11 [0, 5.99] 5%	2.13 [0, 5.99] 5%	0.15 [0, 5.99] 5%	-0.14 [-1.20, 1.20] 5%	2.63 [0.60, 5.40] 5%	4.55% [0%, 10.0%] ad-hoc
Government Expenditure	3.16 [0, 18.30] 5%	1.40 [0, 18.30] 5%	0.19 [0, 5.99] 5%	0.06 [0, 5.99] 5%	0.87 [0, 5.99] 5%	-0.24 [-1.20, 1.20] 5%	1.97 [0.60, 5.40] 5%	4.55% [0%, 10.0%] ad-hoc
Gross Capital Formation	11.04 [0, 18.30] 5%	18.89 [0, 18.30] 5%	3.21 [0, 5.99] 5%	1.49 [0, 5.99] 5%	0.07 [0, 5.99] 5%	0.09 [-1.16, 1.16] 5%	3.27 [0.67, 5.33] 5%	0.00% [0%, 10.0%] ad-hoc
Exports	14.73 [0, 18.30] 5%	14.30 [0, 18.30] 5%	4.41 [0, 5.99] 5%	0.61 [0, 5.99] 5%	0.31 [0, 5.99] 5%	0.20 [-1.16, 1.16] 5%	2.47 [0.67, 5.33] 5%	0.00% [0%, 10.0%] ad-hoc
Imports	7.23 [0, 14.10] 5%	3.53 [0, 14.10] 5%	0.36 [0, 5.99] 5%	0.61 [0, 5.99] 5%	1.14 [0, 5.99] 5%	0.64 [-1.28, 1.28] 5%	2.44 [0.43, 5.57] 5%	9.09% [0%, 10.0%] ad-hoc

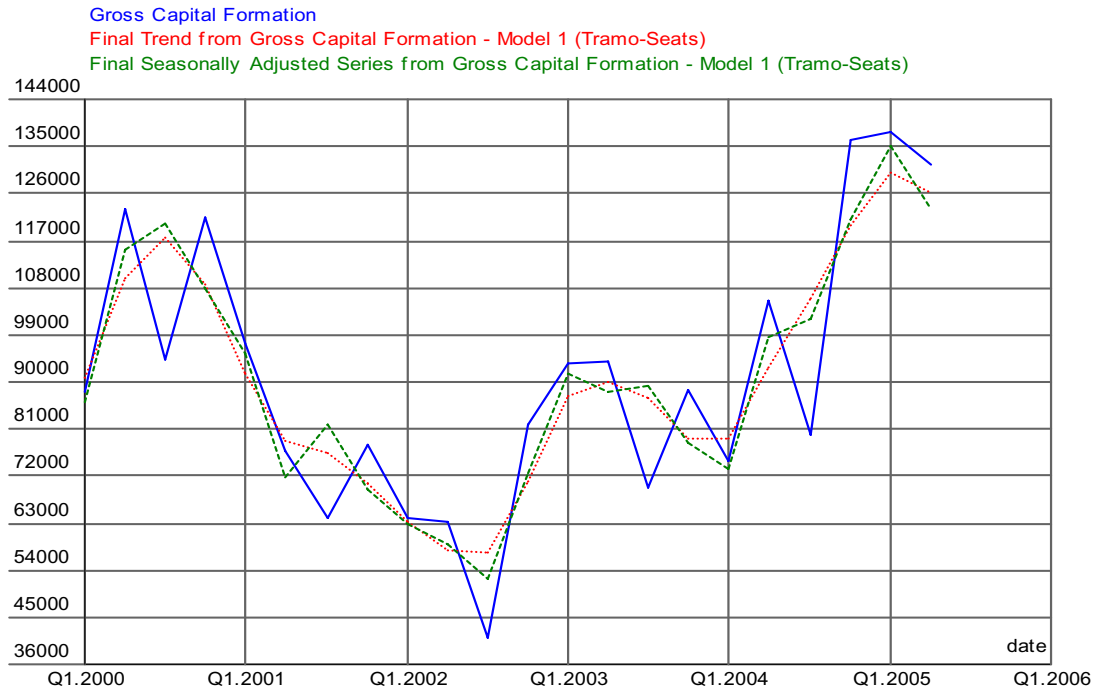
**Figure 1. Consumption at current prices**



**Figure 2. Government consumption expenditure at current prices**

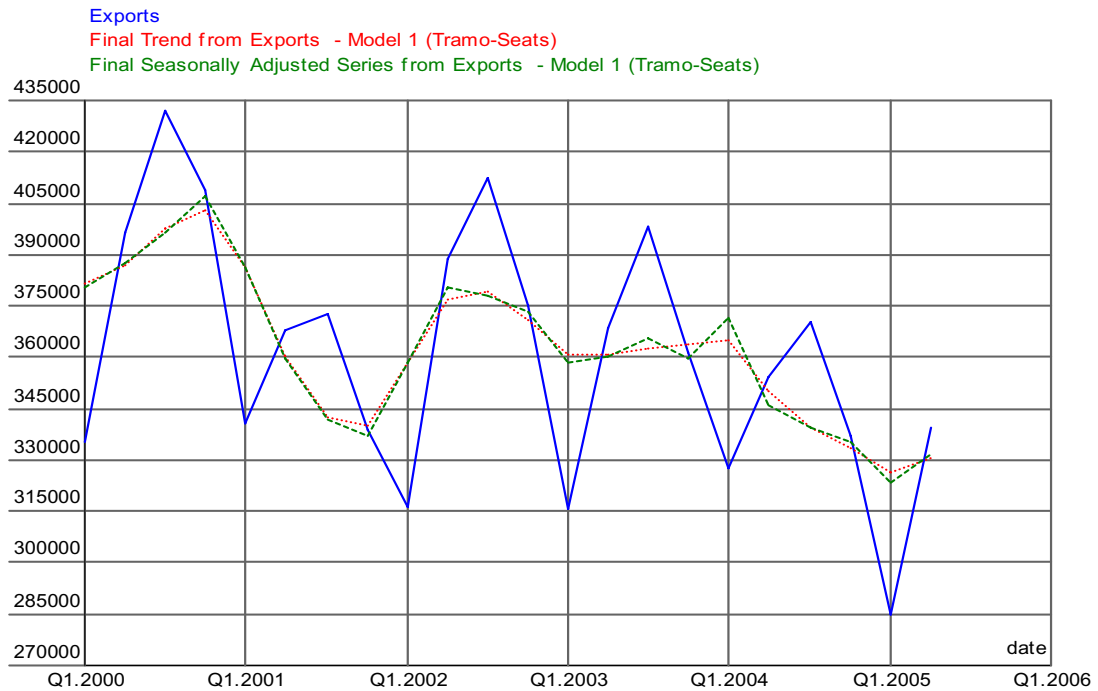


**Figure 3. Gross Capital Formation at current prices**



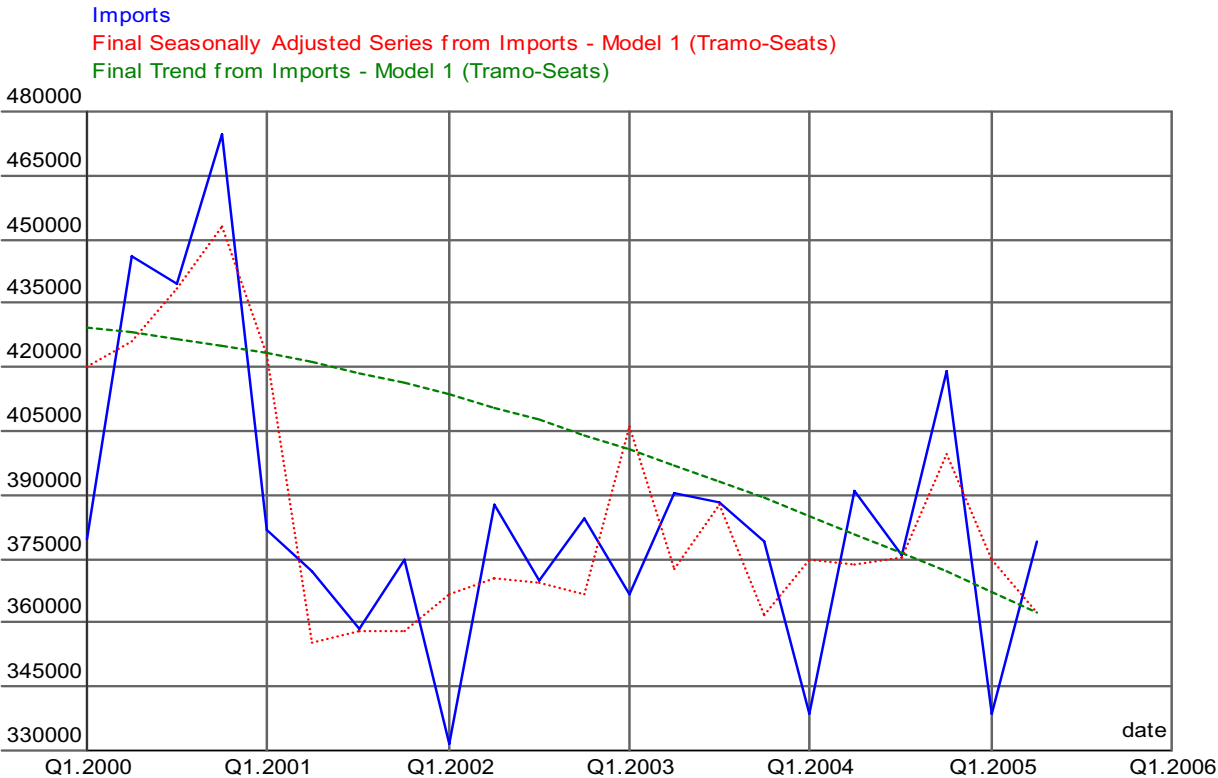
Continuous line: actual data  
 Dotted line: final trend line  
 Dashed line: final seasonally adjusted data

**Figure 4. Exports of Goods and Services at current prices**



Continuous line: actual data  
 Dotted line: final trend line  
 Dashed line: final seasonally adjusted data

**Figure 5. Imports of Goods and Services at current prices**



Continuous line: actual data  
 Dotted line: final seasonally adjusted data  
 Dashed line: final trend line

**Table 5. Original data at constant prices**

		Lm'000						
Period		Consumption	Government Expenditure	Gross Capital Formation	Exports	Imports	GDP	% change (Q <sub>t</sub> /Q <sub>t-1</sub> )
2000	Q1	252,834	82,893	87,930	335,428	379,734	<b>379,351</b>	
	Q2	263,098	81,582	123,140	396,469	446,044	<b>418,245</b>	10.25
	Q3	274,420	79,599	94,246	431,898	439,456	<b>440,707</b>	5.37
	Q4	283,008	83,206	121,445	409,028	474,865	<b>421,822</b>	-4.29
2001	Q1	248,915	77,488	94,466	379,982	403,650	<b>397,201</b>	-5.84
	Q2	262,337	81,556	74,133	402,932	396,578	<b>424,380</b>	6.84
	Q3	278,424	77,925	61,787	398,563	387,096	<b>429,603</b>	1.23
	Q4	281,502	89,700	75,408	368,995	403,039	<b>412,566</b>	-3.97
2002	Q1	259,739	84,070	58,595	340,480	347,348	<b>395,536</b>	-4.13
	Q2	265,468	91,065	60,683	415,726	411,183	<b>421,759</b>	6.63
	Q3	274,524	82,320	38,530	436,471	391,378	<b>440,467</b>	4.44
	Q4	261,166	82,360	75,747	402,542	403,096	<b>418,719</b>	-4.94
2003	Q1	258,193	93,505	86,730	347,881	401,524	<b>384,785</b>	-8.10
	Q2	264,261	90,051	86,930	394,717	429,220	<b>406,739</b>	5.71
	Q3	283,283	81,919	64,895	420,640	423,741	<b>426,996</b>	4.98
	Q4	276,590	84,227	81,966	392,871	409,057	<b>426,597</b>	-0.09
2004	Q1	252,633	89,322	68,787	365,669	382,131	<b>394,280</b>	-7.58
	Q2	261,392	88,415	96,439	394,565	432,581	<b>408,230</b>	3.54
	Q3	283,105	84,806	73,385	407,091	421,367	<b>427,020</b>	4.60
	Q4	279,542	89,686	124,384	392,959	464,767	<b>421,804</b>	-1.22
2005	Q1	235,786	83,456	124,873	322,439	371,503	<b>395,051</b>	-6.34
	Q2	254,323	85,512	118,807	371,656	412,408	<b>417,890</b>	5.78

**Table 6. Final seasonally adjusted series at constant prices**

		Lm'000						
Period		Consumption	Government Expenditure	Gross Capital Formation	Exports	Imports	GDP	% change (Q <sub>t</sub> /Q <sub>t-1</sub> )
2000	Q1	268,260	82,504	86,998	372,986	410,387	<b>400,361</b>	
	Q2	267,109	80,249	115,005	387,308	434,982	<b>414,688</b>	3.58
	Q3	267,969	82,535	119,926	403,372	438,448	<b>435,355</b>	4.98
	Q4	269,133	82,038	107,218	406,460	453,565	<b>411,284</b>	-5.53
2001	Q1	264,765	77,124	93,462	422,528	436,229	<b>421,650</b>	2.52
	Q2	267,137	80,223	69,237	393,621	386,743	<b>423,475</b>	0.43
	Q3	270,081	80,799	78,626	372,240	386,208	<b>415,538</b>	-1.87
	Q4	269,724	88,442	66,574	366,678	384,967	<b>406,451</b>	-2.19
2002	Q1	273,646	83,674	57,970	378,606	375,381	<b>418,515</b>	2.97
	Q2	271,966	89,576	56,675	406,120	400,981	<b>423,355</b>	1.16
	Q3	265,118	85,357	49,034	407,642	390,479	<b>416,670</b>	-1.58
	Q4	251,577	81,207	66,874	400,009	385,027	<b>414,640</b>	-0.49
2003	Q1	271,067	93,062	85,802	386,838	433,929	<b>402,841</b>	-2.85
	Q2	272,176	88,579	81,186	385,600	418,569	<b>408,971</b>	1.52
	Q3	271,851	84,940	82,587	392,857	422,766	<b>409,471</b>	0.12
	Q4	267,148	83,048	72,365	390,393	390,720	<b>422,234</b>	3.12
2004	Q1	265,090	88,899	68,051	406,619	412,975	<b>415,685</b>	-1.55
	Q2	269,413	86,970	90,066	385,454	421,848	<b>410,056</b>	-1.35
	Q3	271,554	87,933	93,393	380,204	420,396	<b>412,687</b>	0.64
	Q4	270,170	88,430	109,814	390,476	443,925	<b>414,964</b>	0.55
2005	Q1	246,477	83,062	123,535	358,550	401,493	<b>410,131</b>	-1.16
	Q2	263,652	84,116	110,957	363,075	402,178	<b>419,622</b>	2.31



**Table 7. Information on models at constant prices**

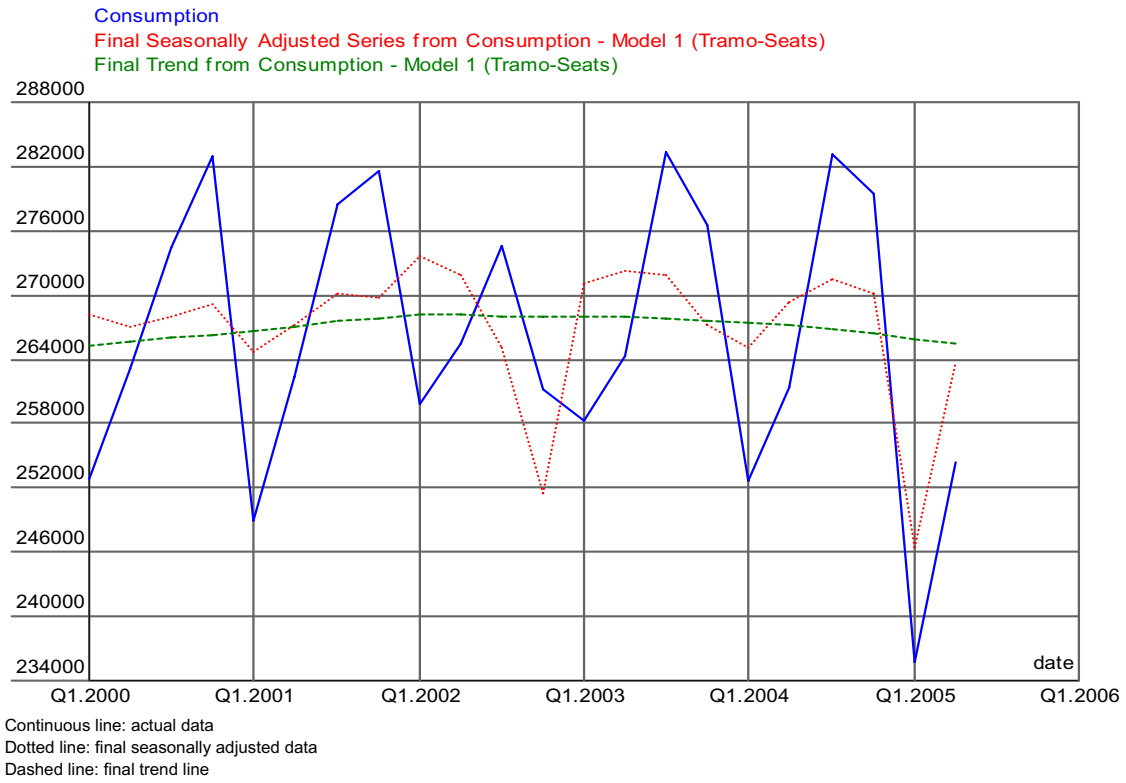
Variable	Status of adjustment	Time span (n° of obs.)	Arima model	Transformation	Mean correction	Outliers	ARIMA decomposition	Seasonality
Consumption	Accepted	Q1.2000 - Q2.2005 (22)	(3 1 1)(0 1 1)	Logarithm	None	Autom.(t-value>2.800):AO,LS,TC; 2: AO Q4.2002, AO Q1.2005,	Exact	Seasonal model used
Government Expenditure	Accepted	Q1.2000 - Q2.2005 (22)	(0 1 1)(0 1 1)	Logarithm	Yes	Autom.(t-value>2.800):AO,LS,TC	Exact	Seasonal model used
Gross Capital Formation	Accepted	Q1.2000 - Q2.2005 (22)	(0 1 1)(0 1 1)	Logarithm	None	Autom.(t-value>2.800):AO,LS,TC	Exact	Seasonal model used
Exports	Accepted	Q1.2000 - Q2.2005 (22)	(0 1 1)(0 1 1)	Logarithm	None	Autom.(t-value>2.800):AO,LS,TC	Exact	Seasonal model used
Imports	Accepted	Q1.2000 - Q2.2005 (22)	(0 1 1)(0 1 1)	Logarithm	None	Autom.(t-value>2.800):AO,LS,TC	Exact	Seasonal model used

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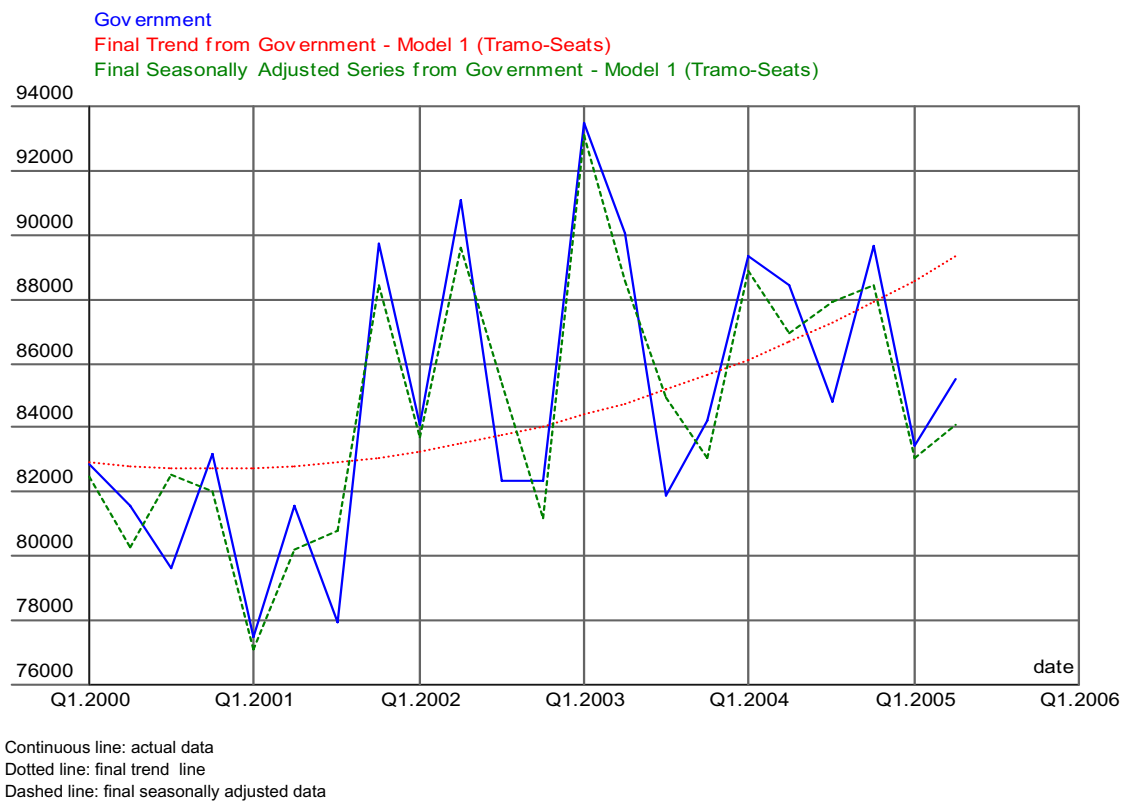
**Table 8. Information on diagnostics at constant prices**

Variable	Ljung-Box on residuals	Ljung-Box on squared residuals	Box-Pierce on residuals	Box-Pierce on squared residuals	Normality	Skewness	Kurtosis	Percentage of outliers
Consumption	3.14 [0, 14.10] 5%	1.76 [0, 14.10] 5%	0.47 [0, 5.99] 5%	0.66 [0, 5.99] 5%	3.65 [0, 5.99] 5%	1.09 [-1.24, 1.24] 5%	4.04 [0.52, 5.48] 5%	9.09% [0%, 10.0%] ad-hoc
Government Expenditure	1.02 [0, 18.30] 5%	3.04 [0, 18.30] 5%	4.21 [0, 5.99] 5%	0.54 [0, 5.99] 5%	0.53 [0, 5.99] 5%	0.19 [-1.20, 1.20] 5%	2.19 [0.60, 5.40] 5%	0.00% [0%, 10.0%] ad-hoc
Gross Capital Formation	13.04 [0, 18.30] 5%	17.38 [0, 18.30] 5%	4.39 [0, 5.99] 5%	1.99 [0, 5.99] 5%	0.01 [0, 5.99] 5%	-0.01 [-1.16, 1.16] 5%	3.11 [0.67, 5.33] 5%	0.00% [0%, 10.0%] ad-hoc
Exports	8.94 [0, 18.30] 5%	13.43 [0, 18.30] 5%	2.35 [0, 5.99] 5%	0.66 [0, 5.99] 5%	0.32 [0, 5.99] 5%	-0.19 [-1.16, 1.16] 5%	2.46 [0.67, 5.33] 5%	0.00% [0%, 10.0%] ad-hoc
Imports	8.32 [0, 18.30] 5%	12.82 [0, 18.30] 5%	1.30 [0, 5.99] 5%	0.51 [0, 5.99] 5%	0.02 [0, 5.99] 5%	0.07 [-1.16, 1.16] 5%	2.91 [0.67, 5.33] 5%	0.00% [0%, 10.0%] ad-hoc

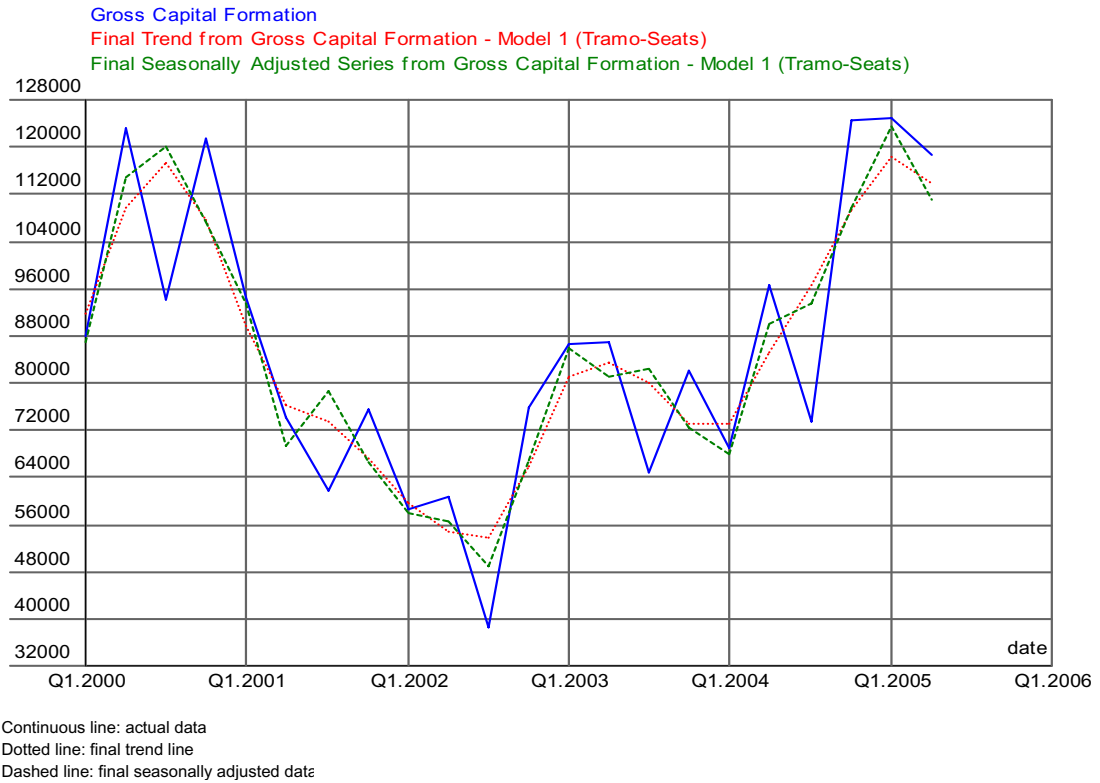
**Figure 6. Consumption at constant prices**



**Figure 7. Government consumption expenditure at constant prices**



**Figure 8. Gross Capital Formation at constant prices**



**Figure 9. Exports of Goods and Services at constant prices**

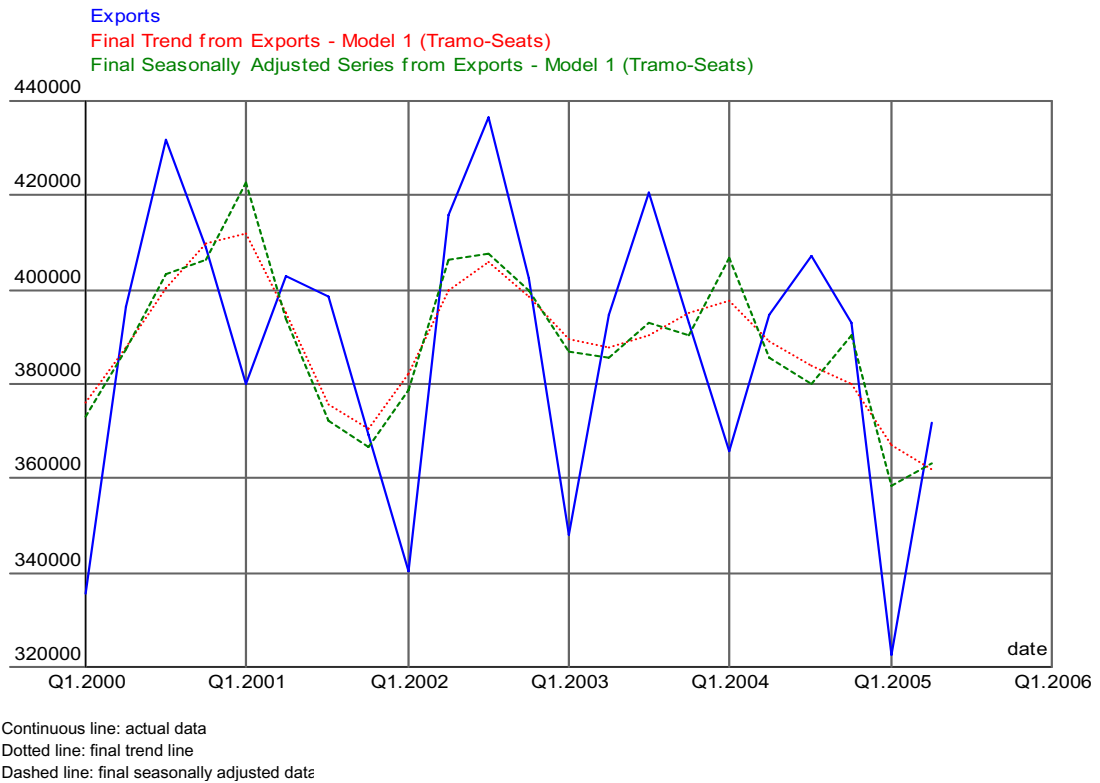
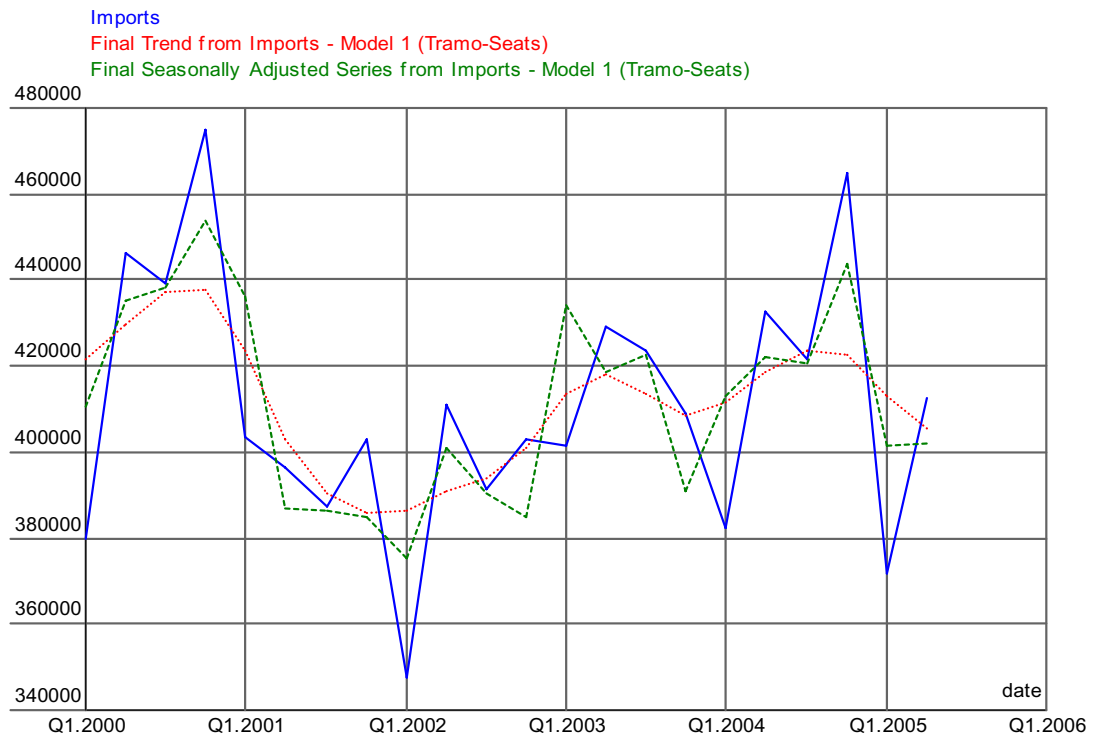


Figure 10. Imports of Goods and Services at constant prices



Continuous line: actual data  
Dotted line: final trend line  
Dashed line: final seasonally adjusted data