Addendum to Advanced Economy Guide
July, 2009

Introduction

The Advanced Economy Guide was written to help novice players understand the Advanced Economy (AdEcon) to the point that they could play and enjoy the game. It was *not* intended to provide enough details to satisfy more experienced players. Therefore, this Addendum was prepared to provide additional information about the AdEcon, so that players can immerse themselves in the system to better understand the full system.

On the pages that follow, details about how resources are produced are presented. I will identify the specific game values used to determine production for each resource, and show where those values can be found. Formulas that can be used to calculate the level of resources expected at any given slider level at any point in the game are provided.

To create each formula, I studied two main resources for information. The first was the Appendix to the Manual. Most of the information is accurately portrayed there, but, it was also necessary to look at the AdEcon code. WCS was very gracious in allowing me to see most of the relevant code, so that I could determine when the calculations occurred and in what order. Several nuances were gleaned from the code that helped make sense of the system. The AdEcon is actually quite elegant, and remarkably simple.

The resulting formulas should be very accurate, as far as they go. There are simply too many extraneous variables that take or add a resource or two here and there for a single formula to account for everything. I wanted to have formulas that are relatively easy to use, so these minor adjustments are simply not included. They do not, however, make much difference in the basic calculations, except for waste. Waste can cripple your production very quickly, but its estimation by formula is problematic, so I did not try to include it in the formulas I present.

To verify the formulas as being sufficiently accurate, I developed a series of spreadsheets that take the variables and calculate estimated resource production as it should occur for each resource, using the first turn of the 1805 Standard Scenario. These calculations were compared, province by province, to the actual production figures so that I could determine the level of error in my formulas. The errors proved to be relatively small, which means that I have captured most everything necessary to understand the system. But, as I always say, there is a level of variability in what you will see, compared to what you expect to see. This Addendum will get you at least “hand grenade” close.

The Slider Settings

The most significant change to the AdEcon is the change in the behavior of the slider settings. In COG, the settings were linear. A full slider setting (75%) generated three times as much as a 25% slider setting, everything else being equal.

In COGEE there are base levels of labor allocations (slider points) for each resource that are the point at which production is maximized. Below that setting, production is decreased proportionately. Above that setting production is half of the amount that you would expect to add by the additional increment. The manual, I believe, either misstates what happens below the base levels, or is somewhat misleading in describing the behavior.

Here are the base levels for each of the sliders:

Agricultural goods: 30%
Developments: 20%
Everything else 10%

At the base level a certain amount of resources are produced. So, let's assume that 12 Food are produced at a 30% setting in Agriculture, given the other variables that are used to drive the production system. As the slider is increased, this amount goes up as described above. So, if you increase the slider to 60%, you'll only get 18 Food. Why? You'll get the 12 for the first 30%, but only 6 for the next 30%. That's half the amount for the second 30% that you got for the first 30%. Incremental production after the base level is halved. That's how it works.

To build a formula that can be used to predict production of a resource, the effect of the slider has to be reduced to a single value, or multiplier. So, to construct the formulas, it was necessary to determine what all the likely multipliers would be for every base level, and for each slider setting at several points. I chose to use increments of 5, for simplicity.

Slider	Agr	Dev	Others
5	0.166667	0.25	0.5
10	0.333333	0.5	1
15	0.5	0.75	1.25
20	0.666667	1	1.5
25	0.833333	1.125	1.75
30	1	1.25	2
35	1.083333	1.375	2.25
40	1.166667	1.5	2.5
45	1.25	1.625	2.75
50	1.333333	1.75	3
55	1.416667	1.875	3.25
60	1.5	2	3.5
65	1.583333	2.125	3.75
70	1.666667	2.25	4
75	1.75	2.375	4.25

***Slider multiplier determination*:**

On the chart to the right, notice that for a slider setting of the base level for any resource, the multiplier is always 1.

For values below the base level, the multiplier is the slider setting divided by the base level.

For a setting that is one half the base level, the multiplier is .5.

For slider values above the base level, the multiplier is based on the amount the slider setting is over the base level. So, for Labor (an Other), if the setting is 40, that is 30 over the base level. Call this "Overage."

You will only get half of the overage to simulate inefficiencies in production. So, using the Labor example above, if the overage is 30, this becomes 15. Now, 15 is one and a half times 10, but you still get the resources the first 10 slider points produce, so you actually get two and a half times the production you would get at 10. That is why the table shows 2.5 as the multiplier.

For you math types, here are the formulas that I used to calculate the multipliers –

At or below the base level: $\frac{Slider\ Setting}{Base\ Level}$

Above the base level: $1 + \frac{Slider\ Setting - Base\ Level}{Base\ Level \times 2}$

Accuracy

To make sure that this was correct, I tested these calculations by comparing the results of the formulas that use the multipliers, considering all the other variables, with the actual production that is realized in the game. This section provides information about the process and provides an example so you can see how to read my spreadsheet snapshots for each of the resources.

Verification of the Formula (for you numbers freaks out there, like me)

For each resource, a spreadsheet was developed to calculate the expected values of produced resources so that those amounts can be compared to the amounts actually shown on the Development Advisor as each slider is moved to the maximum value. The goal was to account for all possible resources that are produced, including any lost to waste, to ensure that the formula I present is correct. This is done province by province with aggregate values calculated for each playable country.

First, the amounts predicted by the formula ("Calc Labor," in this example) were compared to the actual amounts seen on the Development Advisor ("Actual Labor"). I used maximum slider values for all the formulas as this would reduce the impact of "rounding" by the code. The differences, assuming that all fractional amounts would be rounded down, are shown in the first "Error" column on the table below.

Then, waste was factored in. The percent of waste from the first Economics report was used to calculate the amount of waste for each province. Again, the results were compared to the "actual" amounts with the results reported in the second Error column, province by province.

The “True Error” represents the results of all calculations as integers, rather than retaining fractions. This is the best estimate of the error in the formulas.

ProvID	City	Province	NationalMorale	Industrial	Labor	Slider	Muliplier	Calc Labor	Actual Labor	Error		Waste	Waste Calc	Net Labor	Error	True Error
150	Antwerp	Flanders	500	2	8	75	4.25	7.00	7	0.0		0	0	7.0	0.0	0
226	Aosta	Savoy	500	0	3	75	4.25	1.00	1	0.0		0	0	1.0	0.0	0
225	Besancon	Franche_Comte	500	1	3	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
63	Bordeaux	Gascony	500	2	5	75	4.25	4.00	4	0.0		0	0	4.0	0.0	0
60	Bourges	Berri	500	2	3	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
138	Bremen	Hanover	500	3	4	75	4.25	4.00	4	0.0		0	0	4.0	0.0	0
56	Brest	Brittany	500	2	4	75	4.25	3.00	3	0.0		0	0	3.0	0.0	0
222	Clermont	Auvergne	500	1	3	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
144	Cologne	Kleves	500	2	4	75	4.25	3.00	3	0.0		0	0	3.0	0.0	0
61	Dijon	Burgundy	500	2	3	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
209	Genoa	Genoa	500	2	4	75	4.25	3.00	3	0.0		0	0	3.0	0.0	0
224	Grenoble	Dauphiny	500	1	3	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
54	Le_Havre	Normandy	500	4	6	75	4.25	8.00	8	0.0		0	0	8.0	0.0	0
57	Le_Mans	Maine	500	3	4	75	4.25	4.00	4	0.0		0	0	4.0	0.0	0
53	Lille	Picardy	500	4	6	75	4.25	8.00	8	0.0		0	0	8.0	0.0	0
232	Luxembourg	Luxemburg	500	1	4	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
223	Lyon	Lyonnais	500	1	4	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
148	Mainz	Palatinate	500	1	3	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
62	Marseilles	Provence	500	3	7	75	4.25	7.00	7	0.0		0	0	7.0	0.0	0
64	Montpellier	Languedoc	500	2	5	75	4.25	4.00	4	0.0		0	0	4.0	0.0	0
71	Nantes	Poitou	500	1	3	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
208	Orleans	Orleanais	500	3	4	75	4.25	4.00	4	0.0		0	0	4.0	0.0	0
59	Paris	Ile_de_France	500	4	7	75	4.25	9.00	9	0.0		0	0	9.0	0.0	0
58	Perigueux	Guyenne	500	3	3	75	4.25	3.00	3	0.0		0	0	3.0	0.0	0
149	Strasbourg	Lorraine	500	2	6	75	4.25	5.00	5	0.0		0	0	5.0	0.0	0
55	Troyes	Champagne	500	4	4	75	4.25	5.00	5	0.0		0	0	5.0	0.0	0
154	Turin	Piedmont	500	1	4	75	4.25	2.00	2	0.0		0	0	2.0	0.0	0
70	Aberdeen	Highlands	250	1	2	75	4.25	1.00	1	0.0		0	0	1.0	0.0	0
73	Belfast	N.Ireland	250	4	4	75	4.25	5.00	5	0.0		0	0	5.0	0.0	0

NationData | Master | Money | **Labor** | Wood | Wool | Iron | Cotton | Food | Horses | Wine | Spice

Finally, the various country totals were used to determine the percent of production accounted for. The sums of all the province production as calculated by the formula are listed at the very bottom of the second spreadsheet (see below). The actual values from the advisor, the percent accounted for by production and the percent accounted for by applying waste are also presented. The final number for each country should be, in a perfect world, 100%

It should be noted that with every resource, the effects of waste are not as accurate as the general formula is for provinces without any waste. This is because of the complexities of homeland vs. non-homeland provinces and their levels of Courts and Culture. It was simply too complicated to easily model, so I just made sure that the totals after waste is considered for a country was reasonably close. In all cases it was.

		Calc Labor	Actual Labor	Error	Waste	Waste Calc	Net Labor	Error	True Error
1	France	102	102	0	0	0	102	0	0
2	Britain	86	86	0	0	0	86	0	0
3	Sweden	14	14	0	0	0	14	0	0
4	Prussia	43	43	0	0	0	43	0	0
5	Austria	53	53	0	0	0	53	0	0
6	Russia	86	71	-15	0.4	-31.2	54.8	16.2	4
7	Turkey	54	48	-6	0.14	-6.86	47.14	0.86	0
8	Spain	30	30	0	0	0	30	0	0

		Calc Labor	Actual Labor	Calc to Actual %	Waste Calc %	→	Accounted For
1	France	102	102	100.0%	0.0%		100.0%
2	Britain	86	86	100.0%	0.0%		100.0%
3	Sweden	14	14	100.0%	0.0%		100.0%
4	Prussia	43	43	100.0%	0.0%		100.0%
5	Austria	53	53	100.0%	0.0%		100.0%
6	Russia	86	71	82.6%	36.3%		118.8%
7	Turkey	54	48	88.9%	12.7%		101.6%
8	Spain	30	30	100.0%	0.0%		100.0%

For this reason, **I do not include waste as a component of the formulas**. The formulas just get too complicated and still result in some error. You will have to estimate the effect of waste on your own.

A second variable that has been excluded from the formulas is the Feudal Level. Again, adjustments for this are not applied to the provinces, but to the total production for the nation. Making the formulas compensate for this is just too complicated when you compare it to the very small total changes you will see from the adjustments. I do, however, point out those instances where the effects of the Feudal Level are evident for the resources.

Also, keep in mind that there are extraneous variables that change actual production amounts that are not present at this scenario's beginning, so they are not included in the formulas or the

verification spreadsheets. The effects of weather, the presence of enemy units, resource altering game events, etc., are not considered. The manual details each of these.

Formula Values

For every resource except textiles and Labor (remember that "Developments" does not produce a resource), there is a base amount of production located in *COG2Province.txt*. This figure represents the proclivity of a province to produce each of the resources. These values are found in the file columns as indicated by the table below.

Column	Resource
HorseProd	Horses
Food	Food
Iron	Iron
Timber	Wood
Wool	Wool
Wine	Wine
Spice	Spice
Luxuries	Luxuries

The higher the number for each of the resources, the greater the amount of that resource that will be produced, everything else being equal.

But, and this is very important, **zero (0) values in these columns are interpreted by the code to be .5, except for Cotton.** That is why the multiplicative nature of the formulas still work; no single value that is multiplied with the others will ever be zero, thus providing some production for each of the resources if there is any slider setting above zero, except Cotton. If Cotton is zero in this file, no Cotton can ever be produced in the province. However, some variables are so small that the amounts produced given the other variables will still be close to zero.

All other values in the formulas can be found in GOG2Start.txt, but these values change during game play. So, while there may be four Factories in a province at the beginning of a scenario, more can be built. The actual number of completed factories is always used in the formula.