EXAMPLE 6

The economy is described by the following data:

Markets	Production sectors X	Y	W	Consumers CONS
PX	100		-100	
PY		100	-100	
PW			200	-200
PL	-40	-60		100
PK	-60	-40		100

* Taxes are applied on a value-added basis, i.e. PL(1+TX). Tax revenue goes to agent CONS, since no government in the model.

```
$PROD:X s:1
       O:PX    Q:100
       I:PL    Q:40     A:CONS   T:TX
       I:PK    Q:60     A:CONS   T:TX

$PROD:Y s:1
       O:PY    Q:100
       I:PL    Q:60
       I:PK    Q:40

$PROD:W s:1
       O:PW    Q:200
       I:PX    Q:100
       I:PY    Q:100


$DEMAND:CONS
       D:PW    Q:200
       E:PL    Q:(100*LENDOW)
       E:PK    Q:100

$OFFTEXT
$SYSINCLUDE mpsgeset M1_1S

*Model 6.1
        PL.FX=1;
        TX = 0;
        LENDOW = 1;
M1_1S.ITERLIM = 0;
$INCLUDE M1_1S.GEN
SOLVE M1_1S USING MCP;

                    LOWER     LEVEL     UPPER    MARGINAL

---- VAR X            .        1.000     +INF       .
---- VAR Y            .        1.000     +INF       .
---- VAR W            .        1.000     +INF       .
---- VAR PX           .        1.000     +INF       .
---- VAR PY           .        1.000     +INF       .
---- VAR PL         1.000      1.000     1.000      EPS
---- VAR PK           .        1.000     +INF       .
---- VAR PW           .        1.000     +INF       .
---- VAR CONS         .      200.000     +INF       .
```

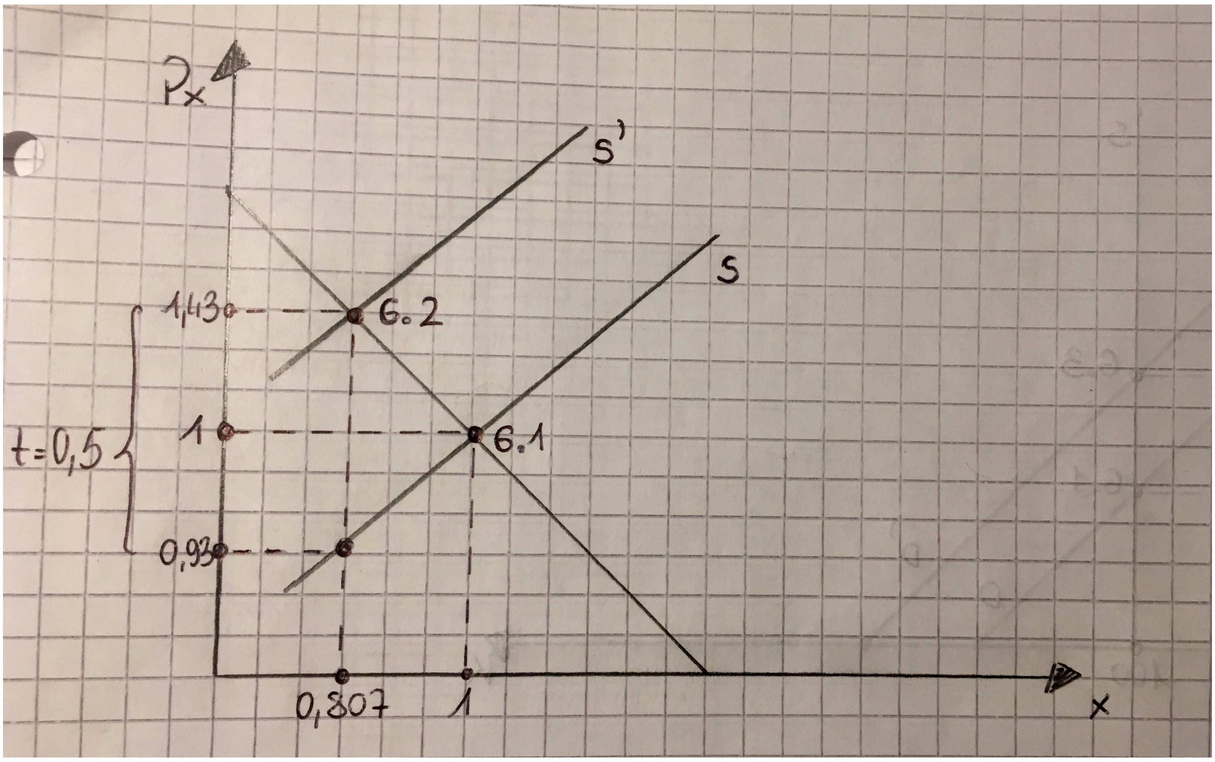
Conclusion: W is defined as a production sector, but this is in fact the welfare, i.e. the aggregate consumption of X and Y by CONS.

***Model 6.2** - Solve a counterfactual with 50% tax and 100% of labor endowment

```
       TX = 0.5;
       LENDOW = 1;
M1_1S.ITERLIM = 2000;
$INCLUDE M1_1S.GEN
SOLVE M1_1S USING MCP;

                        LOWER     LEVEL     UPPER    MARGINAL

---- VAR X                .       0.807     +INF       .
---- VAR Y                .       1.191     +INF       .
---- VAR W                .       0.981     +INF       .
---- VAR PX               .       1.430     +INF       .
---- VAR PY               .       0.968     +INF       .
---- VAR PL             1.000     1.000     1.000 3.553E-13
---- VAR PK               .       0.923     +INF       .
---- VAR PW               .       1.177     +INF       .
---- VAR CONS             .     230.769     +INF       .
```



Conclusion:

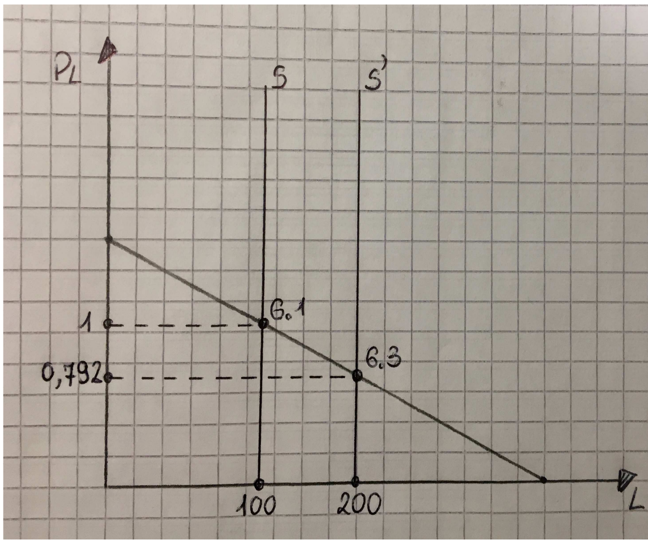
- Tax on inputs for sector X implies ↑PX and ↓PY ⇒ demand on X decreases, while Y becomes more competitive.
- Consumer preferences are described by utility function U(X,Y)=X*Y, i.e. he prefers the same amount of goods when the prices are identical. The tax implies ↑PX > ↓PY ⇒ ↑PW (price of total consumption) ⇒ ↓W
- In addition ↓PK because production of ↓X is capital intensive (exogenous assumption K=const, L=const, PL=const).

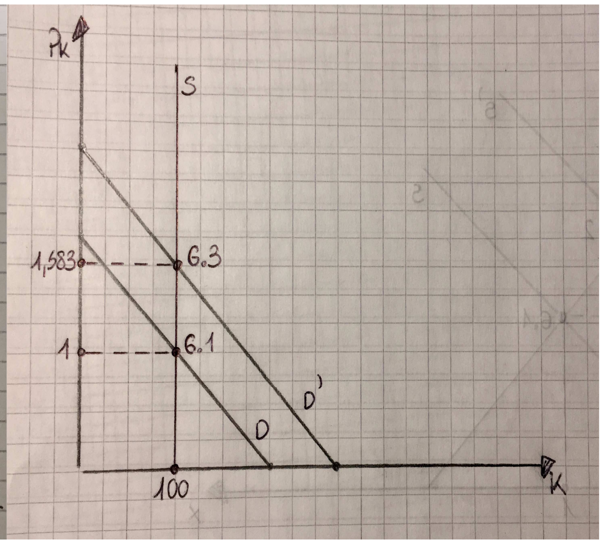
```
*Model 6.3 - Solve a counterfactual with 200% labor endowment
       TX = 0;
       LENDOW = 1*(1+100%)= 2;
$INCLUDE M1_1S.GEN
SOLVE M1_1S USING MCP;
                     LOWER     LEVEL     UPPER    MARGINAL

---- VAR X             .       1.320     +INF      .
---- VAR Y             .       1.516     +INF      .
---- VAR W             .       1.414     +INF      .
---- VAR PX            .       1.516     +INF      .
---- VAR PY            .       1.320     +INF      .
---- VAR PL          1.000     1.000     1.000 6.537E-13
---- VAR PK            .       2.000     +INF      .
---- VAR PW            .       1.414     +INF      .
---- VAR CONS          .     400.000     +INF      .
```

↑supply of L ⇒ ↓PL (however, PL=1 as a numeraire. If another normalization methods are applied, then PL=0.792 – see example 6a.3)

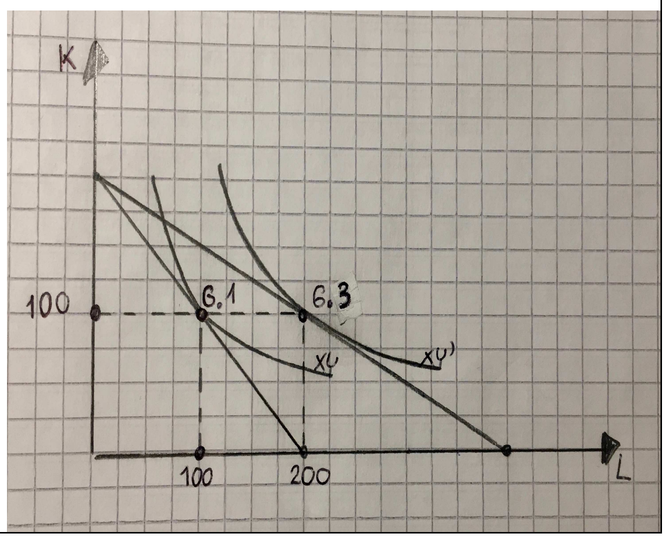
↑L and fixed supply of K ⇒ ↑demand on K ⇒ ↑PK (however, PK=2 when Pl is a numeraire. If another normalization method is applied, then PK=1.583 – see example 6a.3)





Conclusion:

- Increase in labor endowment (↑L), fixed K, and unique elasticity of substitution implies increase of production, where ↑X < ↑Y because Y is more labor intensive.
- More X and Y means higher aggregate consumption W.
- Substituting K by L means that demand on K↓, but supply of K=const. It means that amount of capital cannot be changed. At the same time demand and supply L↑, while PL=const. Initial relationship PK/PL=1 because endowment was K=L=100. Now K=100 and L=200 ⇒ PK/PL=2 ⇒ PK↑
- Higher cost of production due to PK↑ implies ↑PX and ↑PY ⇒ PW↑



6A

Verify that relative prices are the same no matter of normalization method

We have to eliminate PL.FX through lower and upper bound:
PL.lo=0;
PL.up=+inf;

Model 6a.1

	LOWER	LEVEL	UPPER	MARGINAL
---- VAR X	.	1.000	+INF	.
---- VAR Y	.	1.000	+INF	.
---- VAR W	.	1.000	+INF	.
---- VAR PX	.	1.000	+INF	.
---- VAR PY	.	1.000	+INF	.
---- VAR PL	.	1.000	+INF	.
---- VAR PK	.	1.000	+INF	.
---- VAR PW	.	1.000	+INF	.
---- VAR CONS	.	200.000	+INF	.

Conclusion: If PL is equal to 1 no matter of definition (through the lower/upper bound or through the fixing), the results (absolute values) are identical

Model 6a.2

	LOWER	LEVEL	UPPER	MARGINAL
---- VAR X	.	0.807	+INF	.
---- VAR Y	.	1.191	+INF	.
---- VAR W	.	0.981	+INF	.
---- VAR PX	.	1.549	+INF	.
---- VAR PY	.	1.049	+INF	.
---- VAR PL	.	1.083	+INF	.
---- VAR PK	.	1.000	+INF	.
---- VAR PW	.	1.275	+INF	-2.980E-8
---- VAR CONS	.	250.000	+INF	3.9510E-8

Relative price
PX/PL = 1.43
PY/PL = 0.968
PK/PL = 0.923
PW/PL = 1.177
CONS/PL=230.8

Conclusion: Relative prices are identical in the models 6.2 and 6a.2

Model 6a.3

	LOWER	LEVEL	UPPER	MARGINAL
---- VAR X	.	1.320	+INF	-3.069E-8
---- VAR Y	.	1.516	+INF	-2.671E-8
---- VAR W	.	1.414	+INF	.
---- VAR PX	.	1.200	+INF	1.2866E-8
---- VAR PY	.	1.045	+INF	-1.802E-8
---- VAR PL	.	0.792	+INF	-1.869E-7
---- VAR PK	.	1.583	+INF	4.2292E-8
---- VAR PW	.	1.120	+INF	-6.483E-8
---- VAR CONS	.	316.667	+INF	2.4130E-7

Relative price
PX/PL = 1.516
PY/PL = 1.320
PK/PL = 2.000
PW/PL = 1.414
CONS/PL=400

Conclusion: Relative prices are identical in the models 6.3 and 6a.3

Using different normalization methods, we get the same results. So the relative prices and the volumes are the same no matter of normalization (no money illusion). This means that PX/PL from model e.g. 6a.2 (no price normalization) equals to PX/PL from model 6.2 (PL is fixed).

$\Downarrow$

It is necessary to provide relative (not absolute) prices and relative income (i.e. to reveals denominator) when interpreting results

6B

Introduce a "typo" in a sector X output

```
$PROD:X s:1
        O:PX    Q:200
        I:PL    Q:40    A:CONS  T:TX
        I:PK    Q:60    A:CONS  T:TX

$PROD:W s:1
        O:PW    Q:200
        I:PX    Q:100
        I:PY    Q:100
```

Model 6b.1

	LOWER	LEVEL	UPPER	MARGINAL
---- VAR X	.	1.000	+INF	-100.000
---- VAR Y	.	1.000	+INF	.
---- VAR W	.	1.000	+INF	.
---- VAR PX	.	1.000	+INF	100.000
---- VAR PY	.	1.000	+INF	.
---- VAR PL	1.000	1.000	1.000	EPS
---- VAR PK	.	1.000	+INF	.
---- VAR PW	.	1.000	+INF	.
---- VAR CONS	.	200.000	+INF	.

Conclusion: We have obtained the error of -100 for X (zero profit condition is not satisfied), since 40+60≠200, and 100 for PX (market clearing condition is not satisfied), since 100≠200.

Model 6b.2

	LOWER	LEVEL	UPPER	MARGINAL
---- VAR X	.	0.807	+INF	-9.197E-8
---- VAR Y	.	1.191	+INF	-6.230E-8
---- VAR W	.	1.387	+INF	.
---- VAR PX	.	0.715	+INF	-2.628E-8
---- VAR PY	.	0.968	+INF	1.2996E-8
---- VAR PL	1.000	1.000	1.000	2.2919E-7
---- VAR PK	.	0.923	+INF	-1.781E-7
---- VAR PW	.	0.832	+INF	1.1542E-7
---- VAR CONS	.	230.769	+INF	.

Conclusion: In the case of tax on X, the typo did not create an error because PX has adjusted (and also W and PW through PX).

Model 6b.3

	LOWER	LEVEL	UPPER	MARGINAL
---- VAR X	.	1.320	+INF	.
---- VAR Y	.	1.516	+INF	.
---- VAR W	.	2.000	+INF	.
---- VAR PX	.	0.758	+INF	.
---- VAR PY	.	1.320	+INF	.
---- VAR PL	1.000	1.000	1.000	8.811E-13
---- VAR PK	.	2.000	+INF	.
---- VAR PW	.	1.000	+INF	.
---- VAR CONS	.	400.000	+INF	.

Conclusion: In the case of labor endowment change, the typo did not create an error because PX has adjusted since 40+60≠200. This adjustment was not possible in model 6b.1 because typo was the only "shock". In the model 6b.3 we have typo and another shock (↑L) at the same time, thus there is a space to adapt the typo through this additional shock.

The following patterns explain why have changed only PX, PW and W

PX↓ because it adjusts to artificially too big supply: 200*1.32 instead of 1.32*(40+60)

1. Zero profit conditions: Cost of Production Gross of Tax = Value of Output

PROFIT X: 100 * PL^0.4 * PK^0.6 * (1+TX) = 100 * PX;
PROFIT Y: 100 * PL^0.6 * PK^0.4 = 100 * PY;
PROFIT W: 200 * PX^0.5 * PY^0.5 = 200 * PW;

2. Market clearance conditions: Output + Initial Endowment = Intermediate + Final Demand

Market X: 100 * X = 100 * W * PX^0.5 * PY^0.5 / PX;

Market Y: 100 * Y = 100 * W * PX^0.5 * PY^0.5 / PY;

Market W: 200 * W = CONS / PW;

Market L: 100 * LENDOW = 40 * X * PL^0.4 * PK^0.6 /PL +
60 * Y * PL^0.6 * PK^0.4 /PL;

Market K: 100 = 60 * X * PL^0.4 * PK^0.6 /PK +
40 * Y * PL^0.6 * PK^0.4 /PK;

3. Income balance: the level of expenditure (CONS) = the value of factor income + tax revenue

Income CONS: CONS = 100*LENDOW*PL + 100*PK +
TX*100*X*PL^0.4*PK^0.6;