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SYSTEM DYNAMICS INVESTIGATION OF
WAGE-PRICE SPIRAL

The main idea of this work is to outline the wage-price spiral. A wage-price spiral is caused by the effect of supply and demand on aggregate prices. The value of the workers` services is derived from the value of the products they help to create. This is the doctrine and the meaning of productivity.

Our work is an application of MacroLab to the Ukrainian economy. MacroLab was developed by Professor David Wheat at the University of Bergen.

Wages are low or high because of the marginal productivity of the worker. What employer can pay for labor is determined by what the consumer is willing to pay the final product into which the labor enters.
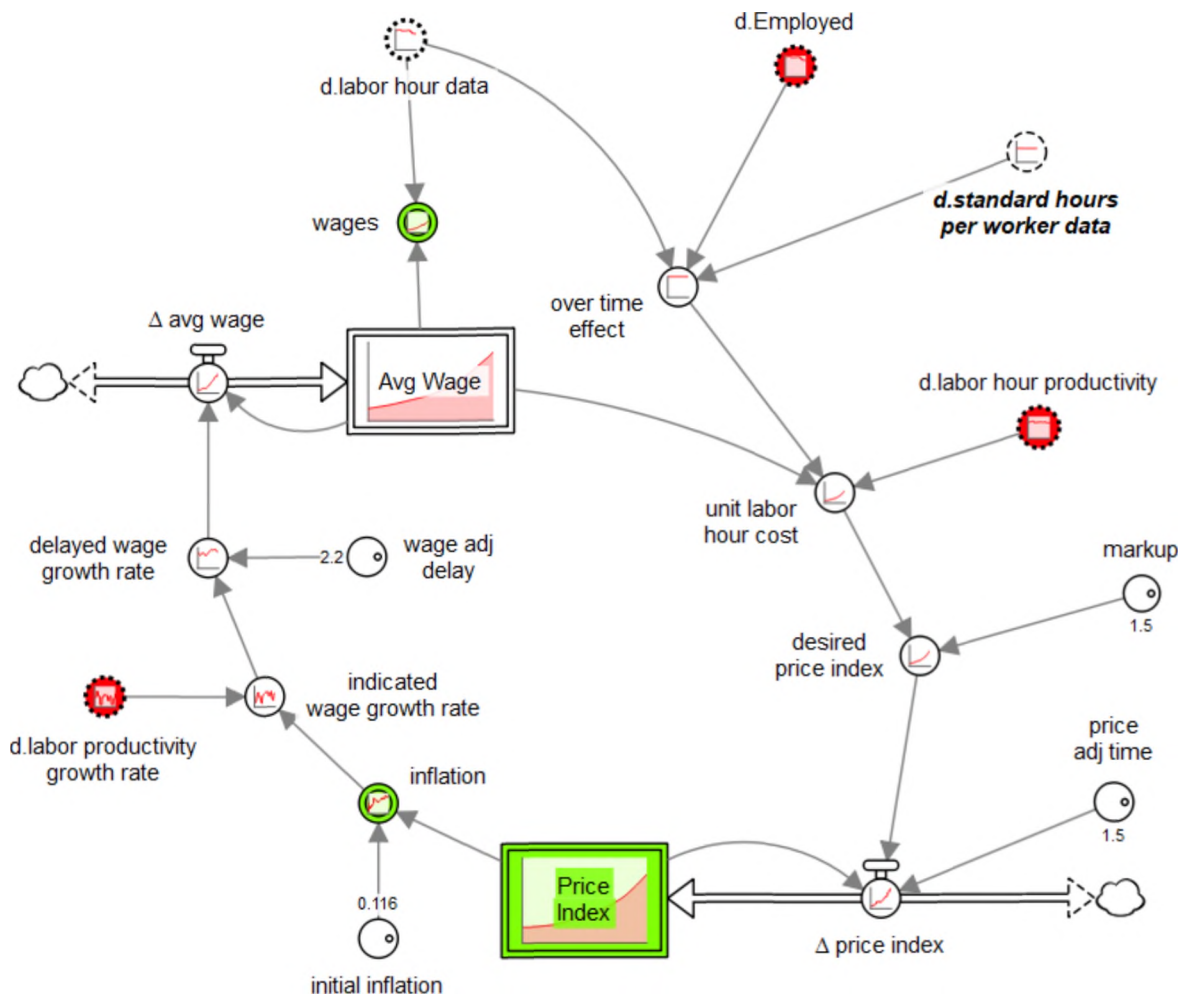
Figure 1. Wage-Price Sub-model

The relationship in wage-price spiral is described by the next equations:

Average Wage (t)= Average Wage (t-1)+ Δ average wage*DT
Δ average wage = Avg Wage*delayed wage growth rate
Unit labor hour cost= (Avg Wage*over time effect)/ labor hour productivity
Desired price index=unit labor hour cost*(1+markup)
Δ Price index = (desired price index-Price Index)/price adj time
Price index (t) = Price index (t-1)+ Δ Price index*DT
Inflation=100*TREND(Price Index, DT, initial inflation)
Indicated wage growth rate=SMTH1((inflation/100+ labor productivity growth rate), .25)
delayed wage growth rate = DELAY1(indicated wage growth rate, wage adj delay)

Wages push inflation, and overall rise in the cost of goods result from a rise in wages. To maintain corporate profits after an increase in wages, employers must increase prices they charge for the goods and services they provide. The overall increased cost of goods and services has a circular effect on the wage increase; eventually, as goods and services in the market overall increase, higher wages will be needed to compensate for the increased prices of consumer goods. In other word, wages chase prices and prices chase wages, but that process takes some time.
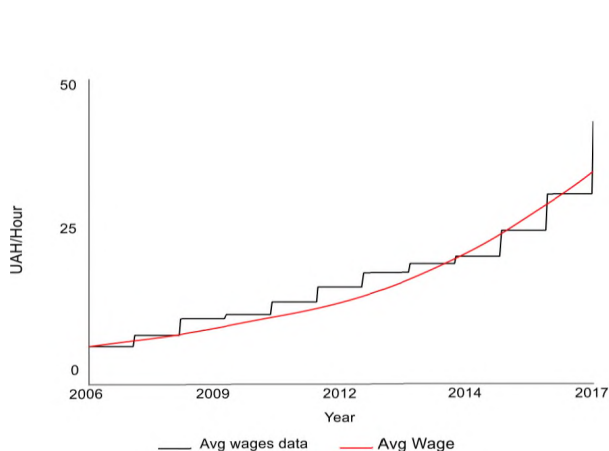

Figure 2. Data of the average wage in Ukraine (actual and simulated data)
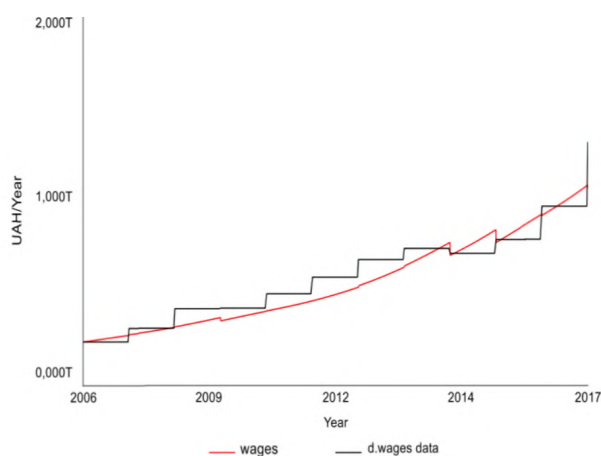

Figure 3. Wages in Ukraine (actual and simulated data)

On the figures 2 and 3 we can see behavior of the historical data and simulated behavior of Wages & Prices sub-model. Data of the average wage in Ukraine, that is, the money received by worker per hour of work. Wages in Ukraine, that is, the funds that all workers in the country receive per year.

The main negative consequence of inflation is the reverse effect on the size of the population's income, which is the key of public welfare.

Every year in Ukraine nominal wages are rising. However, an increase in the nominal wage is not a good indicator of improving the well-being of the population. Real wages are a set of goods and services that an employee can buy for his or her nominal wage. Note, that the growth rates of nominal and real wages differ significantly in Ukraine.

From 2006 to 2014 Ukraine had slow increase in wages in national currency, starting from 2014, Ukraine had fast increase in wages in national currency (Hryvnia) but decrease in value of Euros and Dollars, because of devaluation of national currency. So, in fact starting from 2014 average wages in Ukraine decreased relatively to the value of the foreign currency.

The Theil statistics help evaluate the percentage of error simulated data from actual one. Ideally, the error, indicated by RMSE should be small. In general, the greater the extent to which the model's dynamics are driven by exogenous inputs, the greater the point by point correspondence of the model and data should be. The exogenous inputs, including their blips and dips, force the model to dance to a particular beat.

The RMSE range from 0 to 18 percentage points (Figure 4). The largest deviation of simulated Average wage from actual data is observed during the Word crisis in 2008-2009 years, also substantial deviation is observed during in 2014-2015 years which are known as "perfect storm" in Ukraine. In general, simulated behavior is close to observed one in Ukrainian economy.
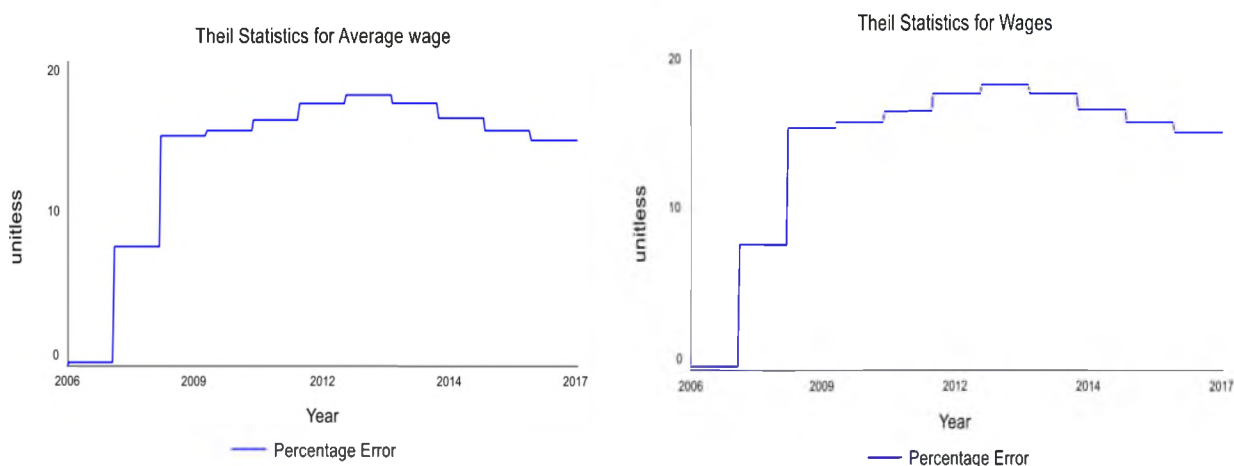

Figure 4. RMSE for variables from Wages & Prices sub-model.

It is worth to note, that markup is the one of the calibrated parameters in the described model. We were confused by uncertainty about amount that producers add to the cost price to determine the selling price. Previously obtained results and conclusions were made with a markup value of 1.5. To evaluate which value of the

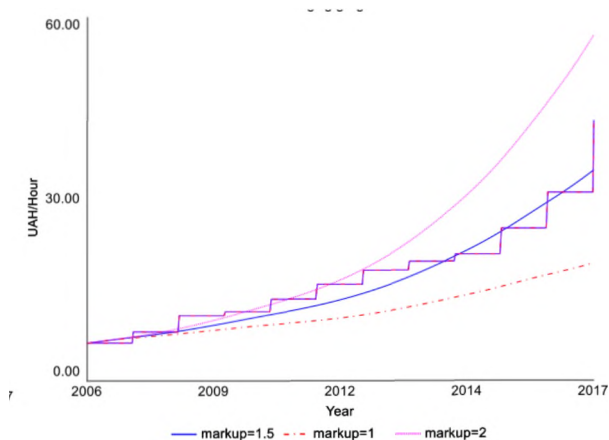markup seems to be more plausible for Ukrainian economy, we conducted a sensitivity test.
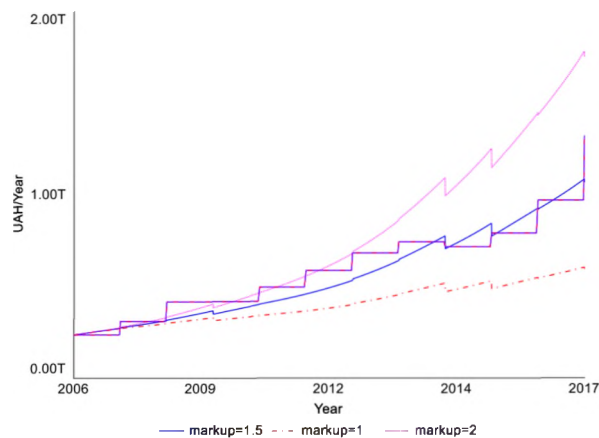

Figure 5. Average wage

Figure 6. Wages

Imposing maximum markups is a common market intervention strategy aiming at protecting consumers from the effects of excessive market power. However, as new research from Christos Genakos, Pantelis Koutroumpis and Mario Pagliero demonstrates, markup ceilings can also provide a focal point for collusion among market participants resulting in higher, instead of lower, prices for consumers.

Therefore, excessive mark-up is one of the reasons for the increase of price index. On the other hand, low markup can make markets weaker.

The Figures 5, 6 indicate that markup is a sensitive parameter, and we can conclude that if the government of Ukraine would take a clear control of the markup, it would have a positive impact on the Ukrainian economy.

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