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Age of machinery and equipment in the Czech agriculture

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Abstract: The paper deals with the estimation and analysis of the average age and the age structure of machinery and equipment in agriculture. The development of the average age of machinery and equipment could be used as an indicator of the modernisation process and the picture of investment support in the industry. For the purposes of the analysis, the official model of the perpetual inventory method is transformed into the Markov chain model. The analysis shows significant differences in the institutional sectors. The average age of machinery and the age distribution depicts the situation in agriculture and it indicates the lower competitiveness of small farmers. The paper contains the prognosis of development of the average age of machinery and equipment in the case of permanent investment on the level of the current year. The international comparison shows that the average age of machinery and equipment in the Czech Republic is close to the level of developed countries. However, the estimated development shows a decreasing average age of the machinery and equipment.

Key words: agriculture industry, average age of assets, Markov chain, gross capital stock, perpetual inventory method, life expectancy

Balances of fixed capital are an integral part of the annual national accounts statistics in most developed countries. Statistical Offices, which respect the international standards, use the perpetual inventory method (PIM) to estimate the net and gross fixed capital stocks and the consumption of fixed capital (OECD 2009; Diewert 2005). The systemic approach to fixed capital precisely distinguishes stocks and the corresponding inflows and outflows. While the gross stock value is continuously falling due to the outflow of retirement, the value of the net fixed capital stock falls also due to the consumption of fixed capital. The consumption of fixed capital is expressed by the depreciation of fixed assets during the period under consideration, as a result of the 'physical deterioration, normal obsolescence and normal accidental damage' (European Commission et al. 2009: 123). The gross fixed capital formation, '... acquisitions, less disposals, of fixed assets during a given period...' (European Commission 2013: 73), serves as the main input for both stocks. Whether they are of a positive or negative value, other changes in the volume (for example catastrophic losses, classification changes, economic appearance of assets) and holding loss/gain can serve as either the inflow or outflow.[1]

Though it is possible to use the business accounts datasets for some analyses (e.g. Čechura 2012), Pigou (1935) points that the capital stock from business accounting is not appropriate for the macroeconomic analysis. The business accounting sums the historical prices (business do not re-evaluate the assets into the prices of the basic year). Moreover, the depreciation is commonly based on the law and the consequent decision of the owner (e.g. two possibilities of the depreciation pattern) (Pakes and Griliches 1984; Hulten and Wykoff 1996).

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[1]For the detailed description and possible variants of the PIM, see the OECD (2009). For the detailed description of the Czech variant of the PIM, see the Czech Statistical Office (2002) and Sixta (2007).

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Although it is usually not the explicitly expressed, fixed capital represents the common part of aims and measures in the strategies, plans or programmes for agriculture. Investment support, investment into new technologies or modernisation of equipment (Ministry of Agriculture of the Czech Republic 2008; Hlaváček et al. 2012) are only different terms for the flows and attributes of fixed capital.

The problem lies in the proper definition of the goals and support of their meaningfulness. Since the modernisation is a proclaimed goal, it should be measurable or at least an indicator of progress should be proposed (Doran 1981; Lawler and Bilson 2013). Without such indicator, it is impossible to prove that the problem really exists and if so, whether the situation was improved or not. Therefore, it is necessary to suggest the indicator which will lead from the intuitively perceived problem to the measurable one.

Even though it is possible to measure or estimate the level of modernisation for an individual firm, there is no such information for the whole industry. In the perspective of modernisation, the average age of fixed capital presents the possible indicator and the progress is indicated as its decrease. Considering the average age of fixed capital, it is beyond the traditional measures but still a possible output from the PIM (Matthews et al. 1982; Harper 2008). The official statistics has different goals, thus the published indicators (Czech Statistical Office 2014) represent mainly the value. As a consequence, a simple indicator for evaluation of the modernisation success is missing.

The aim of the paper is to estimate the average age of machinery and equipment in agriculture as it is classified in the official statistics and international standards by the classification CZ-NACE rev. 2 (Czech Statistical Office 2015). The estimation is based on data used for the construction of official balances of fixed capital. For these purposes, we transform the perpetual inventory method into the Markov chain. The average age is estimated for different institutional sectors for comparison of the situation in these sectors.

Moreover, the age structure estimation in single years allows also the analysis commonly used in the demography. Age analysis is not focused only on the actual situation. Understanding the machinery and tools retirement (retirement function used for the Czech PIM by the Czech Statistical Office) leads to the life expectancy analysis for assets of different age. Thus, our analysis is applied on the chosen intervals from the inverse of the cumulative distribution function (e.g. quartiles, median).

The first part of the article includes a brief description of fixed capital and its measurement. The following section explains the transformation of the Czech perpetual inventory method into the Markov chain. The main part of the article focuses on the results. We provide the analysis of average age of machinery and equipment for the most important institutional sector in agriculture. The results show a significant difference in the age and age structure for households and nonfinancial institutions. Despite the fact that the data on the average age of fixed capital are scarce and the methodology differs, we compare the situation with other countries (the United States of America and the Commonwealth of Australia) that publish the average age of the capital. In spite of the incomparable size of economies, the results show interesting similarities and also depict different dynamics of the provided indicator.

MATERIAL AND METHODS

For the age structure analysis, we use the possibility of the transformation of the Czech version of the PIM into the Markov chain (Krejčí 2010, 2013). When we define the age of asset in years as the particular state, the states in aging process (age cohort or retirement) depends only on the previous states and the transition probability. In other words, the aging process has the Markov property (Tjims 2009) defined in (1) where n represents the stage (end of the year for the balance of fixed capital) and X is the state (possible age in years):

$$P(X_n = i_n | X_0 = i_0, \dots, X_{n-1} = i_{n-1}) = $$
$$= P(X_n = i_n | X_{n-1} = i_{n-1}) \quad (1)$$

We apply the gross fixed capital stock for the age estimation due to the demography analogy (Krejčí and Sixta 2012) – we do not consider the net fixed capital stock as the demography does not apply the productivity of the age cohort for the average age calculation. The transition matrix $\boldsymbol{P}$ is created from the retirement function used for the purposes of the PIM. The matrix has $m + 1$ rows and columns, where m states the maximum service life (maximum age). The $m + 1$ is the absorbing state for the retired assets.

Such modification of the Czech version of the PIM into the Markov chains is inspired by the maintenance models (Tijms 2009; Van der Duyn and Vanneste

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1990). Despite the fact the assets are not naturally homogenous, the model is applicable due to the expression of assets by their value. The probability of the assets retirement in n^{th} period a_n is obtained from the official retirement function. The survival probability of n^{th} year of service r_n comes from (2):

$$r_{i-1} - r_i = a_i,\ i = 0, \dots, m,\ r_0 = 1 \qquad (2)$$

The elements of $\boldsymbol{P}$ are calculated from the (3) and (4). The conditional probability that the asset will retire in an n^{th} year is $p_{n,m+1}$ and $p_{n,n+1}$ represents the conditional probability of aging from n to $n + 1$:

$$p_{n,m+1} = \frac{a_n}{r_{n-1}} \qquad (3)$$

$$p_{n,n+1} = \frac{r_n}{r_{n-1}} \qquad (4)$$

The vector of gross fixed capital stock $\boldsymbol{g}_t$ in year t is calculated by equation (5), where $\boldsymbol{g}'^T_t$ is the row vector of gross fixed capital stock in the age structure. Thus, j^{th} element of the vector contains the gross fixed capital formation that survived j years up to year t. Vector $\boldsymbol{g}_t$ equals $\boldsymbol{g}'_t$, but the first element contains the inflows (mainly gross fixed capital formation) of year t:

$$\boldsymbol{g}'^T_t = \boldsymbol{g}^T_{t-1}\boldsymbol{P} \qquad (5)$$

The value of fixed capital stock is the sum of the m elements from the vector $\boldsymbol{g}_t$. The last element adds the retired assets form the examined period. For the calculation of net fixed capital stock and the consumption of fixed capital, which are not relevant for this paper, see Krejčí and Sixta (2012).

Our calculation is based on the data from the Czech Statistical Office used for the annual National Accounts Statistics (Czech Statistical Office 2014). We apply the same log-normal retirement pattern as the Czech Statistical Office. The average service life of transport equipment in agriculture is 15.9 years, the average service life of other machinery and equipment is 14.7 (Czech Statistical Office 2002: 228–229)[2]. All indicators are in prices of 2005. For the purposes of the age analysis, we have implemented the software compatible with the Czech Statistical Office data sources and transforms the official PIM model into the Markov chain approach.

Thereafter, we transform the official retirement function into life tables, similarly to the demographical analysis. The classic construction of life tables is the model based on the stationary population where the number of deaths and births is equal. Consequently, we can construct life tables for example for the hypothetical number of 100 000 new machines (all methodology is available in Wilmoth et al. 2007).

If we know the log-normal retirement pattern, then we can compute the hypothetical number of the retirement machines as:

$$R_x = 100\,000 \times r_x \qquad (6)$$

where r_x is the ratio of the retirement machines (from the log-normal distribution) at the given age x.

Then we can calculate the number of machines which survive to the age $x + 1$ as:

$$l_{x+1} = l_x - R_x \qquad (7)$$

Note that l_0 is the radix of the life table and it is usually 100 000 (or 10 000). The number of machines at the age x (between age x and $x + 1$) is:

$$L_x = l_x - \frac{1}{2} \times R_x \qquad (8)$$

The total number of machine years remaining to be lived by the cohort beyond the age x:

$$T_x = \sum_{i=x}^{\infty} L_i \qquad (9)$$

The machine life expectancy at age x is:

$$e_x = \frac{T_x}{l_x} \qquad (10)$$

The possibility for the international comparison lies in the comparison of the unique statistics on the average age of fixed capital of the U.S. Bureau of Economic Analysis and the Australian Bureau of Statistics. To apply the comparison correctly, we had to adjust our methodology to be as close as possible to these available statistics. Despite the fact that the national economy of the Czech Republic is incomparably smaller than the U.S. and the Australian economies,

[2]For comparison, the Netherland's statistical office applies 9 years average service life on passenger cars and other road transport equipment in agriculture and 14 years on machinery and equipment (OECD 2009: 204–206). Transport equipment in Italy has the average service life 10 years, machinery has 18; 12 and 15, respectively, in Belgium (OECD 2009: 211). In the case of more specified equipment, tractors have 10 years average service life in Canada, 9 years in the USA, 18 in Germany and 20 years in Norway (OECD 1993: 16, OECD 2001: 105–111).

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the age of assets comes from the structure and the relative representation of age cohorts. Therefore, the comparison of the average age based on the relative representation of cohorts is still meaningful.

The Australian Bureau of Statistics publishes the average age of fixed capital in the structure of the type of assets or industry but not in the combination of both (Australian Bureau of Statistics 2014). In this case, we include also the estimates of other types of assets in agriculture. Due to the fact that the other significant types are the cultivated assets and buildings and constructions, we still recommend to apply only the average age of machinery and equipment as an indicator of modernisation. The age of the cultivated assets is not directly connected with the modernisation; moreover, the productivity of some assets of that type grows with age for some period of the service life. Aging of buildings and constructions does not necessarily represent obsolescence. From the methodology perspective, due to their long service lives, the stocks integrate more other changes, the estimation of which could be considered as one of the most problematic during the balance sheets compilation (Ondruš 2011).

On the other hand, the U.S. Bureau of Economic Analysis provides the average age of equipment in different industries (U.S. Bureau of Economic Analysis 2014) as weighted age of past investment but in the form of the age of net stock (U.S. Bureau of Economic Analysis 2013). Similarly to the Australian Bureau of Statistics, we choose the gross stock for the strict age analysis. We use the already mentioned analogy to demography where the gross stock is much closer to the simple amount of persons. The net stock puts a higher weight to newer assets, therefore, the estimated average age is lower in comparison with the average age measured from the gross stock.

For the purposes of the comparison with the U.S. estimates, we have to take into account different depreciation profiles used by the official statistics (OECD 2009). To get as close as possible to the U.S. the geometric depreciation profile, we adopt the double declining balance principle to transform the average service life into the depreciation rate.

Equation (11) shows the straight-line depreciation used by the Czech Statistical Office (2002). The variable p_n represents the value of an asset in the age of n years, p_0 is the value of the new asset and T stands for the average service life:

$$\frac{p_n}{p_0} = 1 - \frac{n}{T}, \qquad n = 0,1, \dots, T \tag{11}$$

The net value of an asset is obtained from (12), where δ represents the depreciation rate:

$$\frac{p_n}{p_0} = (1 - \delta)^n \tag{12}$$

To transform service lives into depreciation, we use the double declining balance formula which is based on two simplifying assumptions (Diewert 2005; OECD 2009) – both depreciation profiles are correct and the investment stands on the level of one unit in constant prices, thereafter the equilibrium stock value under straight-line depreciation is:

$$1 + \frac{T-1}{T} + \dots + \frac{2}{T} + \frac{1}{T} = \frac{T(T+1)}{2T} = \frac{T+1}{2} \tag{13}$$

The long-run equilibrium value under the same conditions and the geometric depreciation is obtained from:

$$1 + (1-\delta) + (1-\delta)^2 + (1-\delta)^3 + \dots = \frac{1}{1-(1-\delta)} = \frac{1}{\delta} \tag{14}$$

The depreciation rate is then obtained from the equality of stocks from (13) and (14):

$$\delta = \frac{2}{T+1} \tag{15}$$

We calculated the alternative net stock in the age structure on the basis of (12) and (15) for the Czech agriculture to compare the average age of equipment with data from the U.S. Bureau of Economic Analysis.

RESULTS AND DISCUSSION

Average age and age structure estimation

Each element of the represents one year cohort. Each cohort contains the value of survived assets in the prices of year 2005. For the age analysis, we use the middle of the possible interval [j – 1, j] for the age of the assets in the cohort (i.e. the youngest cohort is considered to be 0.5 year old, the following 1.5 etc.). Consequently, the average age v in the year t is calculated as the weighted arithmetic mean of the cohort's age, where the weight is the accumulated value of assets in that cohort:

$$v = \frac{\sum_{j=1}^{m}[g_t(j) \cdot (j - 0.5)]}{\sum_{j=1}^{m} g_t(j)} \tag{16}$$

Figures 1 and 2 show the age structure of machinery and equipment in agriculture in the years 2000 and

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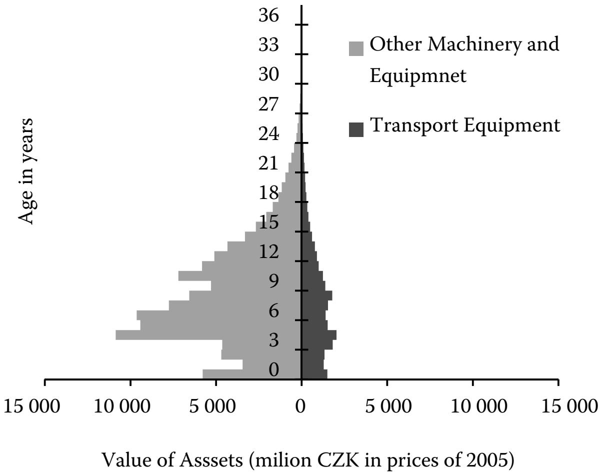

Figure 1. Age structure of machinery and equipment in the year 2000 (millions CZK in prices 2005)

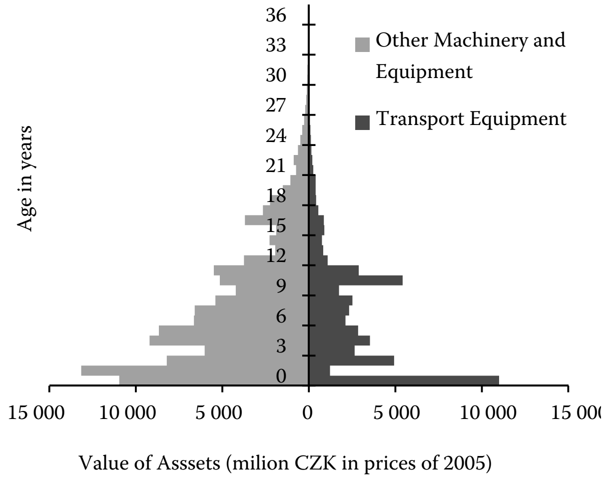

Figure 2. Age structure of machinery and equipment in the year 2012 (millions CZK in prices 2005)

2012. The left side shows the value of cohorts of the transport equipment, other machinery and equipment are on the right side of the figures. The value is in million CZK in the prices of 2005. Figure 1 also shows the significant improvement of investment in the last years (0–2 cohorts). The official estimation of investment 2012 could change due to the fact only the semi-definitive version is published (see Fischer et al. 2013 for the impact of the data revisions on the derived indicators).

The development of the average age of machinery and equipment in agriculture is seen in Figure 3. In the period between the years 2000 and 2012, the age of transport equipment averages 7.35 years and the age of other machinery and equipment averages 8.64. The maximum average age of transport equipment was reached in the year 2000 (8.11 years), the minimum 6.66 years is estimated for the year 2002. Similarly, the maximum average age of other machinery and equipment was reached in the year 2006 (9.06 years) and the minimum in the 2012 (7.50 years).

Furthermore, Figure 3 shows the development of the average age of machinery and equipment in the sector of non-financial institutions (75.03% of the gross stock of transport equipment and 76.15% of the gross stock of other machinery and equipment in agricul-

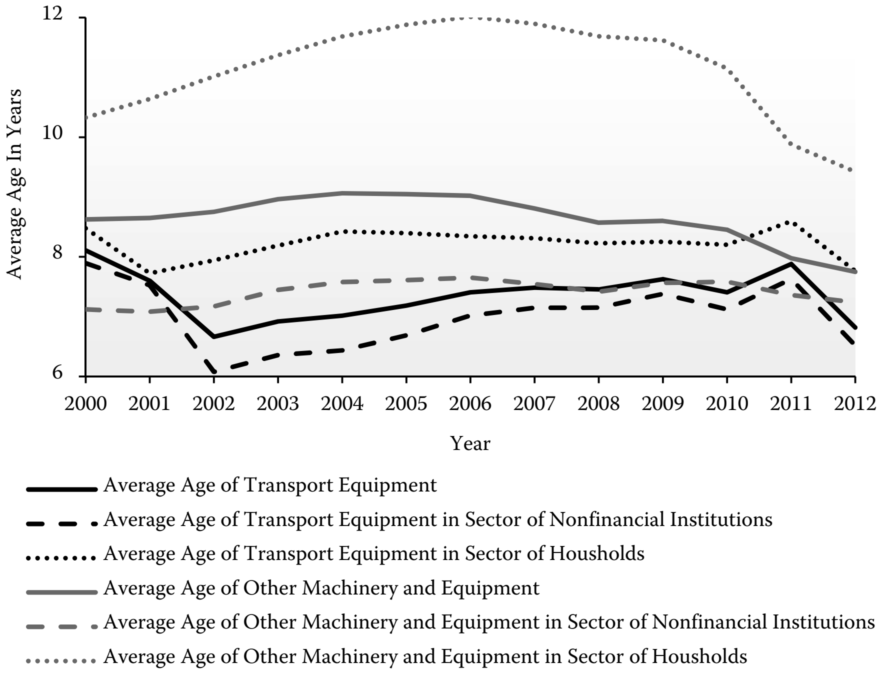

Figure 3. Average age of machinery and equipment

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Table 1. Selected quantiles of the age distribution of other machinery and equipment

Quantile	Age distribution of Other machinery and equipment					
	sector of Non-financial Institutions			sector of Households		
	2000	2006	2012	2000	2006	2012
Lower quartile	3.0	2.3	1.6	5.9	5.6	1.3
Median	4.6	5.9	5.0	8.9	11.7	6.3
Upper quartile	9.0	10.0	9.7	12.2	15.2	14.3

ture industry in 2012 (Czech Statistical Office 2014)) and households (24.78% and 23.53% respectively). Despite the fact that the trend is nearly the same, the households' (in this case represented by small farmers) machinery and equipment is significantly older in comparison with the non-financial institutions. The biggest difference can be found in the year 2007 where the average age of other machinery and equipment in households is 1.58 times bigger than in the non-financial institutions (11.90 vs 7.54 years). In average, the average age of transport equipment in households is 1.18 times bigger than in the sector of non-financial institutions and 1.50 times bigger for other machinery and equipment.

The significant drop of the average age in the years 2011–2012 is caused by the mentioned increase of investment in the actual years. The age of other machinery and equipment is decreasing from year 2004 (2006 for households), which could be connected with the Czech Republic accession to the European Union. Anyway, regarding the increasing value of the gross fixed capital stock together with the decreasing average age of machinery and equipment demonstrates the modernisation process.

The other possibility to describe the changes in the age distribution are quantiles. The lower quartile (25% quantile), the median (50% quantile) and the upper quartile (75% quantile) are used to analyse the changes in the age distribution. Table 1 contains the average age of other machinery and equipment for different quantiles. The results show that the age distribution of other machinery and equipment is almost stable for the non-financial institutions, but for households' sector the distribution is changing in time and its position is shifted (in comparison with the non-financial institutions) into older ages. The first difference is found in the year 2006 where the median of the households other machinery and equipment rises from 8.9 years to 11.7 and also the upper quartile rises to 15.2 years. In 2012, there was a significant decrease described above when the lower quartile for households falls from 5.6 year to 1.3 (25% of machinery were younger than 1.3 years) and median from 11.7 to 6.3. The upper quartile falls just slightly to 14.3 from 15.2. It means that the oldest quarter of machinery was in majority not replaced.

The age distribution of transport equipment changes too. For the non-financial institutions, the lower quartile in 2012 fell from 2.7 years to 0.7 (25 % of transport equipment were younger than 0.7 years) but the median and the upper quartile were stable in that time. For households, the changes were significantly smaller.

Life expectancy of other machinery and equipment vary much more. For example the lower quartiles for the non-financial institutions and households are nearly the same in 2012 (13.1 and 13.3). On the other hand, the life expectancy for the lower quartile was 11.7 years for the non-financial institutions and 8.9 for the households in year 2000. The source of that difference lies in the older machinery of households, which means that its lifespan is shorter.

Table 2. Selected quantiles of the age distribution of transport equipment

Quantile	Age distribution of Transport Equipment					
	sector of Non-financial Institutions			sector of Households		
	2000	2006	2012	2000	2006	2012
Lower quartile	2.8	2.7	0.7	2.9	3.0	1.8
Median	5.9	4.0	4.4	6.9	6.0	5.5
Upper quartile	9.9	9.1	9.4	10.7	11.3	10.5

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Table 3. Life expectancy of other machinery and equipment

Quantile	Life expectancy of Other machinery and equipment					
	sector of Non-financial Institutions			sector of Households		
	2000	2006	2012	2000	2006	2012
Lower quartile	11.7	12.4	13.1	8.9	9.2	13.3
Median	10.1	8.9	9.7	6.7	5.6	8.6
Upper quartile	6.7	6.2	6.3	5.4	4.8	5.0

Table 4. Life expectancy of transport equipment

Quantile	Life expectancy distribution of Transport Equipment					
	sector of Non-financial Institutions			sector of Households		
	2000	2006	2012	2000	2006	2012
Lower quartile	13.1	13.2	15.2	13.0	12.9	14.1
Median	10.1	11.9	11.6	9.2	10.0	10.4
Upper quartile	7.1	7.6	7.4	6.8	6.5	6.8

To sum up the age from Table 1 and the life expectancy from Table 3, we can estimate the average lifespan for different age of machinery. For example, the estimated lifespan for the lower quartile in all ages is 14.7 years (that is clear because in the lower quartile, we have only young machineries). But for the upper quartile, the life expectancy differs for the non-financial institutions and households and lifespan is different as well. For the non-financial institutions, the lifespan of the oldest machineries is around 16 years for all selected years. The lifespan for households is 17.6 years in 2000, 20 years in 2006 and 19.3 in 2012.

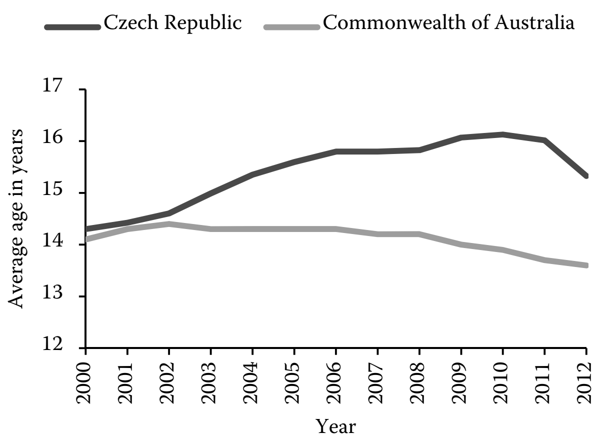

Figure 4. Comparison of the average age of fixed capital: the Czech Republic vs. the Commonwealth of Australia

Source: Australian Bureau of Statistics (2014) and own calculation

Very similar results can be found in Table 4, but the lifespans do not differ between the non-financial institutions and households as for other machinery and equipment.

International comparison

From the perspective of the international comparison, two comparisons were made; the Czech Republic and the Commonwealth of Australia comparison, and the Czech Republic and the USA comparison.

Figure 4 compares the average age of gross fixed capital in the Czech Republic and the Commonwealth of Australia. Although the behaviour is significantly different in the examined period, the average age of the capital is surprisingly close, the biggest difference is 2.3 years (14.5% of current average age in the Czech Republic) in 2011. In the year 2000, the difference is only 0.2 of year.

Table 5 contains the basic descriptive statistics of the presented period. The average rate of growth shows the main difference – the average age of fixed assets was growing in the Czech Republic and decreasing in the Commonwealth of Australia in average. On the other hand, Figure 4 shows that the trend in the Czech Republic has significantly changed in the recent years.

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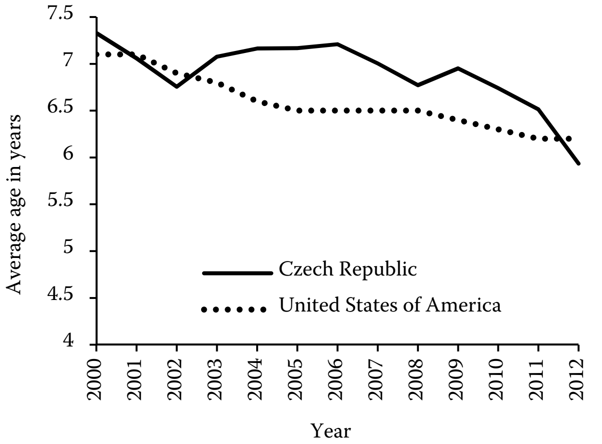

Figure 5. Comparison of the average age of fixed capital: the Czech Republic vs. the United States of America

Source: U.S. Bureau of Economic Analysis (2014) and own calculation

Figure 6 compares the average age of net stock of equipment in agriculture. The net capital structure gives higher weights to newer assets, therefore the level and behaviour is different from the previous estimates based on the gross stock.

In the case of comparison of average age in the U.S. and the Czech Republic, the differences seem marginal. The Figure 5 still depicts the difficulties with aging of capital in the Czech Republic in the middle of the examined period.

The international comparison shows that the average age of machinery and equipment in the Czech Republic is on the level of the developed countries. The worsening situation from the middle of the examined period was reversed and the actual trend leads to the early convergence to the compared countries in the terms of age of machinery and equipment.

Possible development of the average age of machinery

The average age of gross fixed capital depends on the retirement distribution and the pattern of the past investment. If the investment into machinery and equipment remains on the actual level, we can assume that the average age of machinery in the household's institutional subsector will reach the average age of the same type of fixed capital in the institutional sector of non-financial institutions within the end of the current EU programming period (2014–2020). Figures 6 and 7 show the development of the average age of machinery and equipment in agriculture when the investment is forecasted by 5-year moving average.

Such investment behaviour would push the average age by more than one year under the level of the year 2000. Both figures show a slight increase of age at last 5 years of the prognosis. This behaviour grows from the aging of the past investment on the current level that get older than the average age.

Such investment would significantly increase the amount of capital in agriculture. The model shows that the value of the gross stock of transport equipment would increase by 52% from the year 2012 to 2020 and the value of gross stock of other machinery and equipment would increase by nearly 30%. A more realistic is the requirement on the model parameters revision in the case of investment on such level. Modernisation is frequently connected with a continuous decrease of service lives (OECD 2009) and the associated increase of retirement.

Such high amount of capital would be unnecessary and on the basis of the investment time series, such investment behaviour is not probable (the value of gross stock of other machinery and equipment has

Table 5. Descriptive statistics of the average age of the gross fixed capital in agriculture, 2000–2012

	Average age of gross fixed capital	Standard deviation	Min	Max	Average rate of growth (%)
Czech Republic	15.4	0.61	14.3	16.1	0.59
Commonwealth of Australia	14.1	0.24	13.6	14.4	–0.30

Table 6. Descriptive statistics of the average age of the net fixed stock of equipment in agriculture, 2000–2012

	Average age of gross fixed capital	Standard deviation	Min	Max	Average rate of growth (%)
Czech Republic	6.9	0.39	5.9	7.3	–1.68
United States of America	6.6	0.29	6.2	7.1	–1.12

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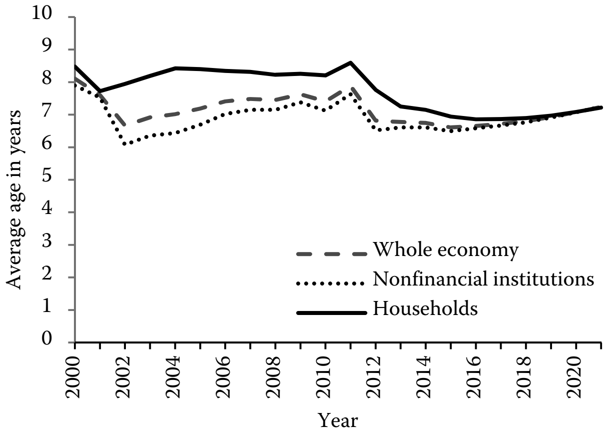

Figure 6. 5-year moving average estimation of investment – impact on the average age of transport equipment in agriculture

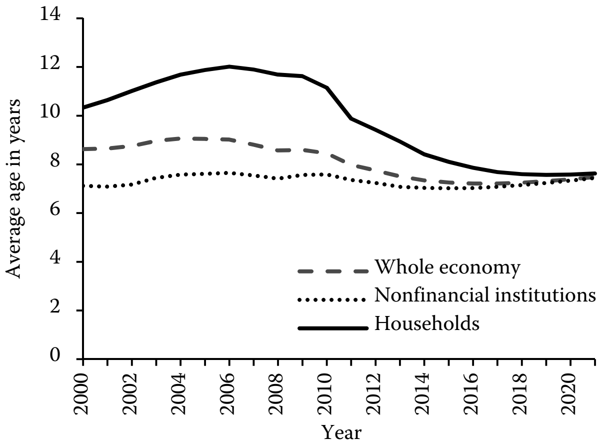

Figure 7. 5-year moving average estimation of investment – impact on the average age of other machinery and equipment in agriculture

increased only by 7.69% from 2000 to 2012), thus the convergence of the average age of machinery and equipment in the households and non-financial institutions sectors will be probably slower. If the current investment behaviour is a short-run pulse, it will have the same consequences as the short-run baby boom – a big portion of the population will reach the retirement age at the same time.

Figure 2 shows a similar pulse in transport equipment. In the year 2002, the new investment represented more than 20% of the overall stock in the industry. This ratio has dropped in 2012 due to the retirement and growth of the following investments but the appropriate 10 years old cohort still represented nearly 10% of the stock. This is the capital that significantly increases the average age of the transport equipment in the industry and it will be the same for the current high investment.

CONCLUSION

The presented results show the decreasing average age of machinery and equipment. Together with the increasing value of the gross capital stock, this development could be considered as a positive indicator of modernisation.

The international comparison does not prove any problematic overall situation in agriculture in the Czech Republic in the terms of obsolescence of machinery and equipment. The situation in the industry was worse in the middle of the examined period 2000-2012 but in the current years, the modernisation process seems to have reached the level of developed countries. Even if it was impossible to state the modernisation goal in terms of the average age in the programmes and strategies (e.g. Ministry of Agriculture of the Czech Republic 2008, Hlaváček et al. 2012) the international comparison shows the success of that process.

On the other hand, the average age and the age distribution significantly differs for the institutional sectors of non-financial institutions and small farmers (represented by the institutional sector of households). The development of the average age of machinery depicts the situation in agriculture and indicates the lower competitiveness of small farmers. From that point of view, the measures focused on the investment support of small-sized enterprises (Ministry of Agriculture of the Czech Republic 2008) are legitimate and important. The future development of the presented methodology should focus on small assets, which represent part of other machinery and equipment from the European System of Accounts 2010. It is possible to expect shorter service lives for these assets. Some countries also assume changing the service lives (usually decreasing) for chosen assets and thus the service lives should be periodically revised (OECD 2009).

The actual investment behaviour indicates also the necessity of future administrative acts. The actualisation of the crucial PIM parameter – the average service life – will be necessary, especially in the case of the remaining high investments.

Last but not least, the data on investment do not reflect some qualitative aspects. When a farmer buys

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a new but already obsolete asset, the difference in prices between the modern and obsolete new asset does not serve as a sufficient compensation. Such obsolete asset has the same age as a new high-tech asset – 0.5 years in our model. We assume that the reflection of this aspect would increase the difference between the households and non-financial institutions, which could be considered richer and take into account the returns to scale that are unreachable by small farmers.

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