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RESEARCH REPORT

IMPACTS OF LABOR PRODUCTIVITY BY AGE AND CHANGES IN AGE STRUCTURE ON LABOR PRODUCTIVITY IN VIETNAM

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1. Rationale and Objectives of the Research

Rationale

- Labor productivity is one of the most important factors reflecting national production capacity, and it is measured in various ways.
- To be comparable, it is usually measured as value-added (VA) per labor. In this measure, however, the role of labor cannot be presented clearly as it is mixed with other factors of production (such as capital, technology, and managerial capacity).

1. Rationale and Objectives of the Research

Rationale

- Total factor productivity (TFP) approach can help to mitigate the above disadvantage in measuring labor productivity, as TFP can separate contributions to economic growth from capital, labor, and other factors. However, the main disadvantage of the TFP approach is that it considers all laborers to have the same productivity, regardless their age, gender, or occupation. This is not true in fact.
- In addition, labor movements/shifts between economic sectors also result in age structure changes in the labor force, which in turn influence sectoral productivity and thus a nation's total productivity and potential economic growth.

1. Rationale and Objectives of the Research

Objectives

This research will:

- Quantify the impact of labor productivity by age on the economy's labor productivity.
- Quantify long-term labor productivity under age-structure changes of the population, given an assumption that labor productivity by age will not be changed
- Combine these issues with the NTA model

2. Analytical Methods and Data

Analytical Methods

- First, we will apply the economic model proposed by Aubert and Crépon (2007) to quantify labor productivity by age. We apply the Cobb-Douglas production function to calculate labor productivity by age, in which output is presented by value added, capital is presented by total fixed capital, and labor is presented by the number of workers, divided into four age groups—15–34; 35–55; 56–60, and 61 and above.
- Second, we apply Shift-Share Analysis (SSA) to quantify the impact on national labor productivity of both labor shifts and growth in labor productivity by age .
- Third, given an assumption that labor productivity by age will not change, the research shows challenges of decreasing labor productivity of the economy in the long-term when population will be rapidly aging.

2. Analytical Methods and Data

Analytical Methods

Let's start with: (1)

$$\ln(Q_{i,t}) = \ln(A)_t + \beta.\ln(K_{i,t}) + \alpha.\ln(\lambda.L_{i,t}) + \varepsilon_{i,t}$$

The output created by total labor ( ) is the sum of the outputs created by labor groups categorized by age

$$\lambda L = \sum_j \lambda_j.L_j = \lambda_0.L\left(\frac{L_0}{L} + \sum_{j-\{0\}}\frac{\lambda_j}{\lambda_0}.\frac{L_j}{L}\right) = \lambda_0.L.\left(1 + \sum_{j-\{0\}}(\frac{\lambda_j}{\lambda_0} - 1).\frac{L_j}{L}\right) \quad (2)$$

Thus, some research uses the following estimation model:

$$\ln(Q_{i,t}) \approx cons_t^Q + \beta.\ln(K_{i,t}) + \alpha.\log(L_{i,t}) + \sum_{j-\{0\}}\alpha.(\frac{\lambda_j}{\lambda_0} - 1)\left(\frac{L_j}{L}\right)_{i,t} + \varepsilon_{i,t} \quad (3)$$

Where,

Q is the output (measured by VA, GO or revenue) of enterprise *i*; input factors include capital K_i and labor contribution ; labor productivity of group *j* là λ_j

=> The estimation result helps identify the contribution of each labor unit by age to growth; it also allows us to measure labor productivity by age

2. Analytical Methods and Data

Analytical Methods

- The research uses Shift-Share Analysis (SSA) to measure the impact of the structural shift by age and productivity growth within each group on overall labor productivity
- P and P_i refer, respectively, to productivity of the economy and productivity of age group i
- Y and Y_i refer, respectively, to total output of the economy created by labor and the output created by age group i
- L and L_i refer, respectively, to total labor and labor in age group i
- The share of labor in age group i in the total labor of the economy is S_i

2. Analytical Methods and Data

Analytical Methods

- We can calculate as follows:

$$P_i = \frac{Y_i}{L_i} \qquad P = \frac{Y}{L} \qquad \sum_{i=1}^{n} \left(\frac{Y_i}{L_i}\right)\left(\frac{L_i}{L}\right) = \sum_{i=1}^{n} (P_i S_i)$$

Where: n is the number of age groups

Consequently, absolute change of labor productivity between the base year (year 0) and year *t* is:

$$\Delta P = P^t - P^0 = \sum_{i=1}^{n} S_i^0 (P_i^T - P_i^0) + \sum_{i=1}^{n} p_i^0 (S_i^T - S_i^0) + \sum_{i=1}^{n} (p_i^t - p_i^0)(S_i^T - S_i^0)$$

The above formula shows that the absolute change of labor productivity between the year 0 and year t is caused by three components, which are presented on the right side of the formula. They are:

- Component 1: Change in productivity of each age group
- Component 2: Change in age structure
- Component 3: Change in interaction

2. Analytical Methods and Data

Data

- This research will use data from the Enterprise Census from 2010 to 2012, combined with data from the Census on Economic, Administrative Institutions in 2012 to estimate labor productivity by age
- This research will also use the results from GSO's population projections for Vietnam in 2009–2049 (GSO, 2011)

3. Initial Results

Ln(VA)	*(1)* *Totlal*	*(2)* *Agr*	*(3)* *Mining*	*(4)* *Manuf*	*(5)* *E_W_Gas*	*(6)* *Constr*	*(7)* *Service*
Ln(Capital)	0.235***	0.455***	0.305***	0.279***	0.395***	0.297***	0.210***
	(0.003)	(0.032)	(0.073)	(0.006)	(0.052)	(0.008)	(0.004)
Ln(Labor)	0.890***	0.553***	0.889***	0.787***	0.768***	0.657***	1.090***
	(0.006)	(0.056)	(0.102)	(0.010)	(0.086)	(0.014)	(0.008)
Worker share							
15-34	0.563***	0.228	0.447	0.729***	-0.093	-0.204	0.279***
	(0.078)	(0.610)	(2.060)	(0.177)	(2.442)	(0.263)	(0.095)
35-55	0.509***	-0.928	0.568	0.737***	-0.666	-0.234	0.349***
	(0.081)	(0.596)	(2.056)	(0.183)	(2.488)	(0.272)	(0.099)
56-60	*0.00*	-1.615**	-1.049	*0.00*	-2.156	*0.00*	*0.00*
	reference	(0.765)	(2.409)	*reference*	(3.044)	*reference*	*reference*
Over 60	-0.614***	*0.00*	*0.00*	-1.488***	*0.00*	-2.428***	-0.544***
	(0.153)	*reference*	*reference*	(0.395)	*reference*	(0.559)	(0.178)
Constant	2.693***	2.374***	2.024	2.265***	2.391	3.840***	2.731***
	(0.079)	(0.575)	(1.900)	(0.178)	(2.420)	(0.269)	(0.096)
Observations	63,069	934	212	14,005	238	7,664	40,016
R-squared	0.545	0.438	0.578	0.665	0.689	0.464	0.522

3. Initial Results

First, on the impact of labor productivity by age on sectoral and national labor productivity:

- Capital and the number of workers had positive impacts on the growth of value added in all sectors of the economy
  - If capital increased by 1%, total value added of all sectors would increase by 0.23%; if the number of workers increased by 1%, total value added would increase by 0.89%
  - Given current growth rates of capital and the number of workers (14%/year and 2%/year, respectively), the contribution to value added of all sectors from capital would be 3 percentage points, while that of labor would be 1.6 percentage points
- Similar results are found in some economic sectors, including agriculture, forestry and fishery; mining; manufacturing; electricity, gasoline, heating, and air conditioning; construction; and services

3. Initial Results

- Young and middle-age workers (those aged 15–34 and 35–55, respectively) contributed positively to the growth of sectoral value added:
  - If the proportion of workers aged 15–34 and 35–55 increased by 1 percentage point, the sectoral value added would increase by 0.56% and 0.51%, respectively. Conversely, if the proportion of workers aged 61 and above increased by 1 percentage point, the sectoral value added would decrease by 0.61%
  - This means that the sectoral labor productivity is not only dependent on labor productivity by age, it is also dependent on the number of workers in each age group: for groups aged 15–34 and 35–55, increasing workers would increase sectoral labor productivity, while increasing workers aged 61 and above would reduce the sectoral labor productivity

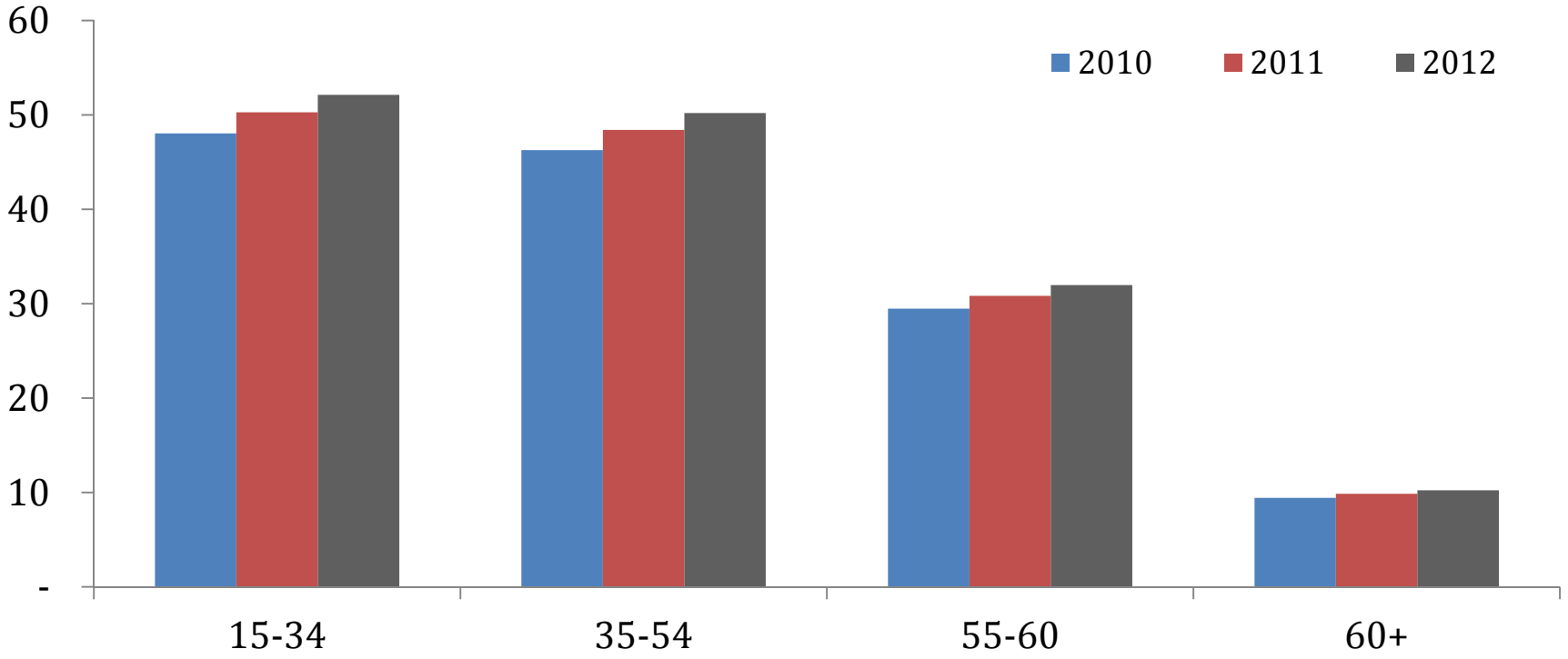
3. Initial Results

- For all sectors, if workers aged 56–60 are considered as the reference group, we find that:
  - Labor productivity of those aged 15–34 is about 1.63 times the reference group's labor productivity
  - Labor productivity of those aged 35–55 is about 1.57 times the reference group's labor productivity
  - Labor productivity of those aged 61 and above is only 0.32 times the reference group's labor productivity (**Figure 1**)
- Similar results are found for manufacturing and services sectors
- Based on the result of model, we calculate the productivity for each age group
  - $\lambda_1 = 1{,}63\lambda_3$ means that the labor productivity of the 15–34 age group is 1.63 times the labor productivity of the 56–60 age group
  - $\lambda_2 = 1{,}57\lambda_3$ means that the labor productivity of the 35–55 age group is 1.57 times the labor productivity of the 56–60 age group
  - $\lambda_4 = 0{,}32\lambda_3$ means that the labor productivity of the 60 and above age group is 0.32 times the labor productivity of the 56–60 age group

3. Initial Results

Fig 1. Labor productivity by age group, 2010–2012

Unit: VND million per capita



3. Initial Results

Second, the impact of labor shifts on the economy's labor productivity in the period 2010-2012 (**Table 1**)

Age group	Labor productivity (VND million per cap.)		Proportion in the total workers (%)		Disaggregation of impacts		
	P(0)	P(t)	S(0)	S(t)	Due to labor productivity change	Due to age-structure change	Due to combined impacts
	2010	2012	2010	2012			
15-34	48.04	52.12	44,0	38,9	1.80	-2.46	-0.21
35-54	46.27	50.21	44,4	46,8	1.75	1.14	0.10
55-60	29.47	31.98	5,4	6,6	0.14	0.36	0.03
61+	9.43	10.23	6,2	7,6	0.05	0.13	0.01
Total	43.85	46.69	100	100	3.73	-0.82	-0.07

3. Initial Results

- Labor productivity—measured by value added per worker—decreased by age, especially for the group 61 and above
- Labor productivity of workers in all age groups increased during 2010–2012
- The amount of increase tended to decrease by age. The youngest workers (15–34) had the highest increase (VND 4.08 million), while the oldest workers (61 and above) had the lowest increase (VND 0.8 million)
- During 2010–2012, the proportion of the youngest workers (15–34) decreased by 5 percentage points (from 44% to 39%), while those for other groups increased slightly (less than 3 percentage points). A partial cause of this trend was that the younger population is decreasing and the middle-age population is increasing

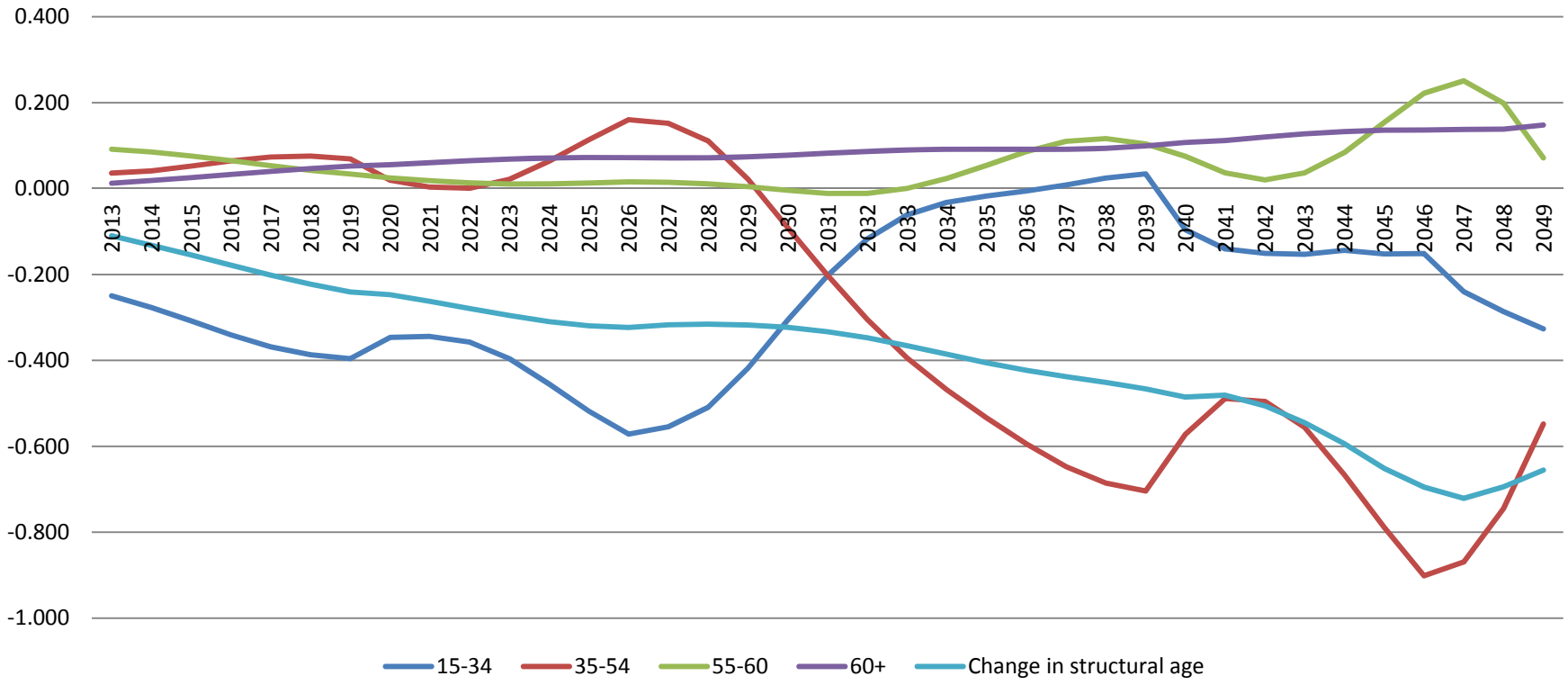
3. Initial Results

- Changes in sectoral labor productivity were mostly due to changes in age structure of workers and labor shifts between sectors, but not due to the combined impacts of these factors
- The youngest workers had the highest labor productivity and contributed nearly 50% of the change in sectoral labor productivity (VND 1.8 million out of VND 3.73 million)
- But this group caused a reduction in sectoral labor productivity because of age structure changes (a reduction of about 3 times that of sectoral labor productivity: VND 2.46 million compared to VND 0.82 million). The main reason was that the proportion of the youngest workers (15–34)—those who had the highest labor productivity—reduced the most

3. Initial Results

Third, given an assumption that labor productivity by age will change, the simulation results for the impact of population age structure changes on national labor productivity show that an aging population will have a negative long-term impact on national labor productivity.

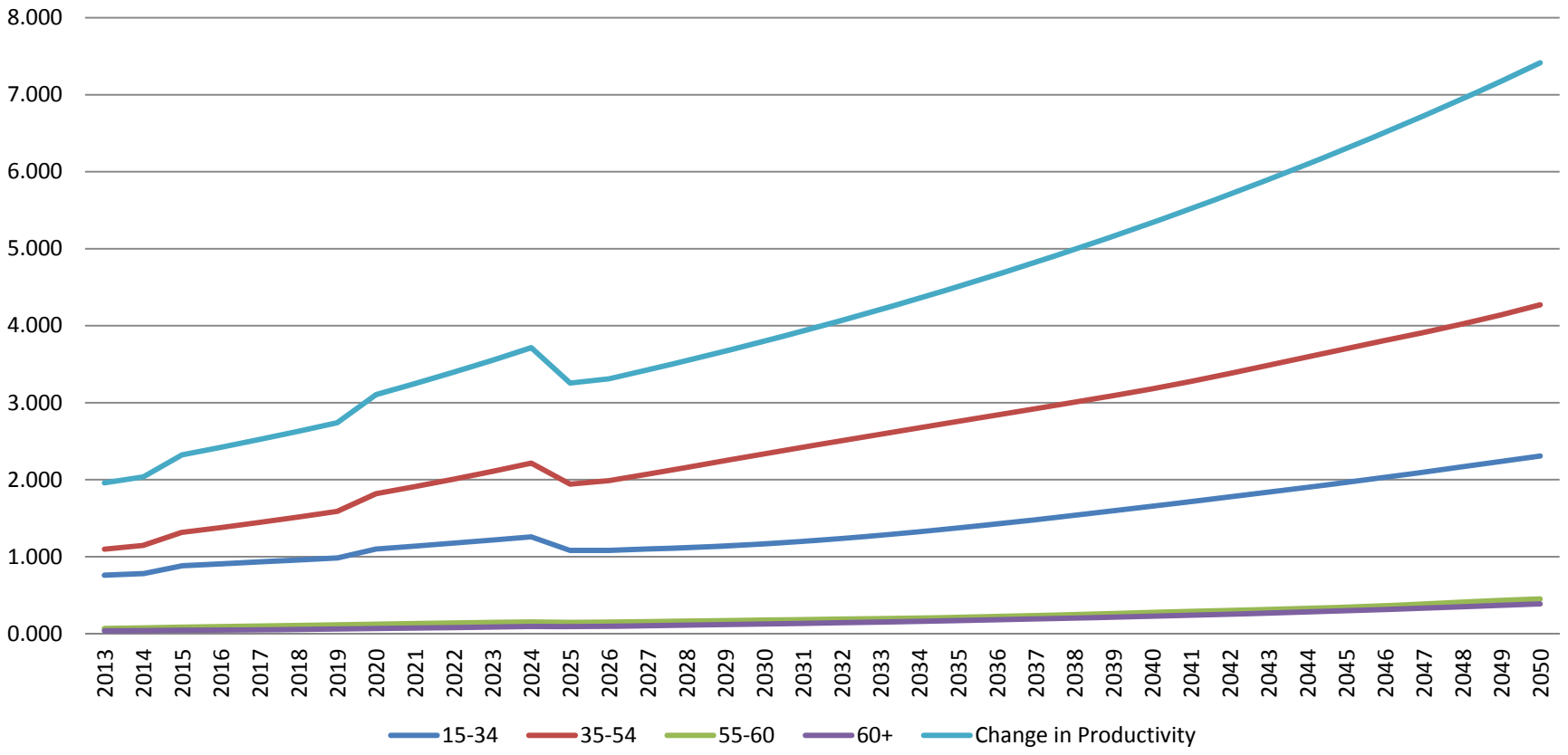
Figure 2. Changes in labor productivity by age and for the whole economy, 2009-2049



3. Initial Results

Fourth, given an assumption that labor productivity by age will change, the simulation results for the impact of age-group productivity changes show an increase in the national labor productivity

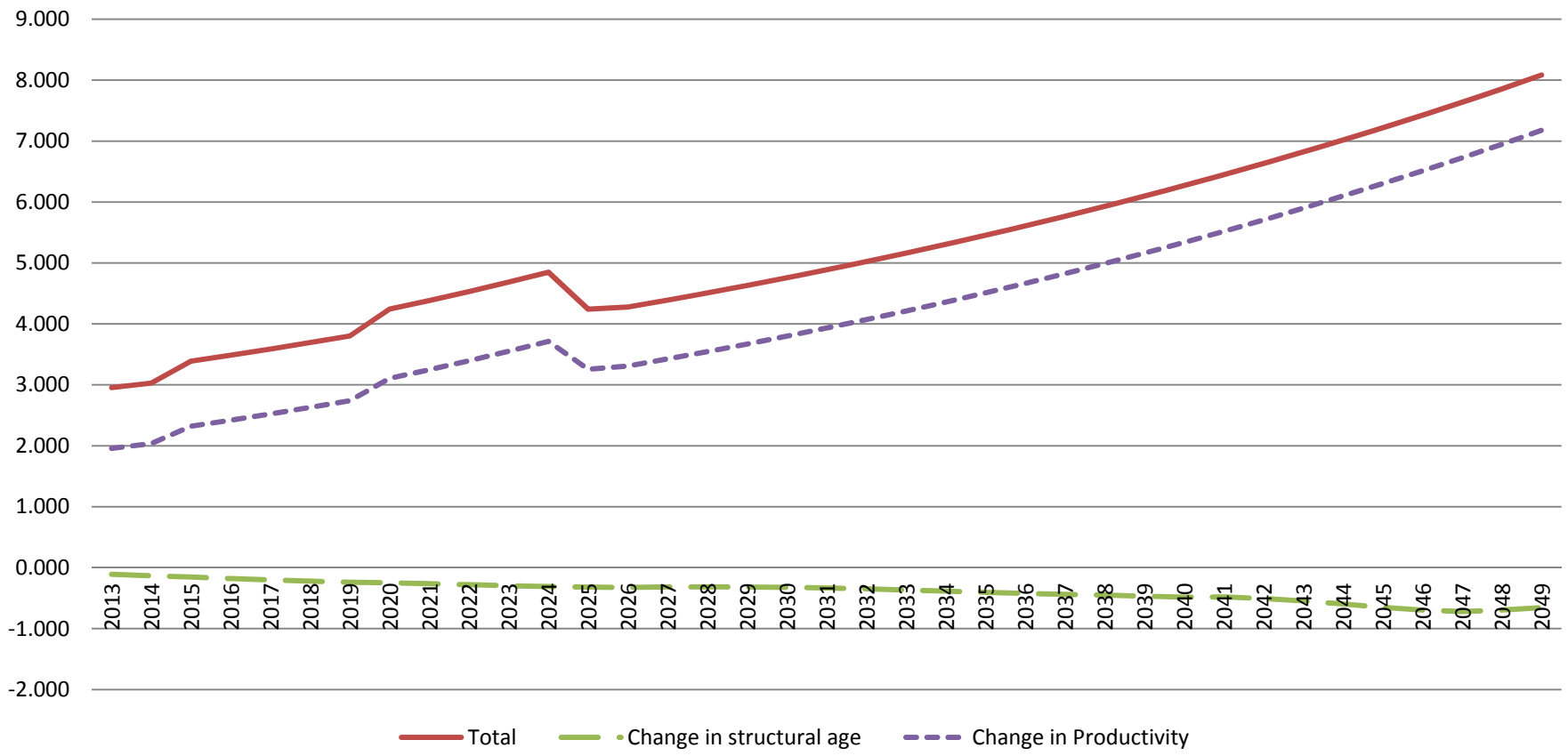
Figure 3. Increase in national labor productivity by productivity changes by age group, 2009-2049



3. Initial Results

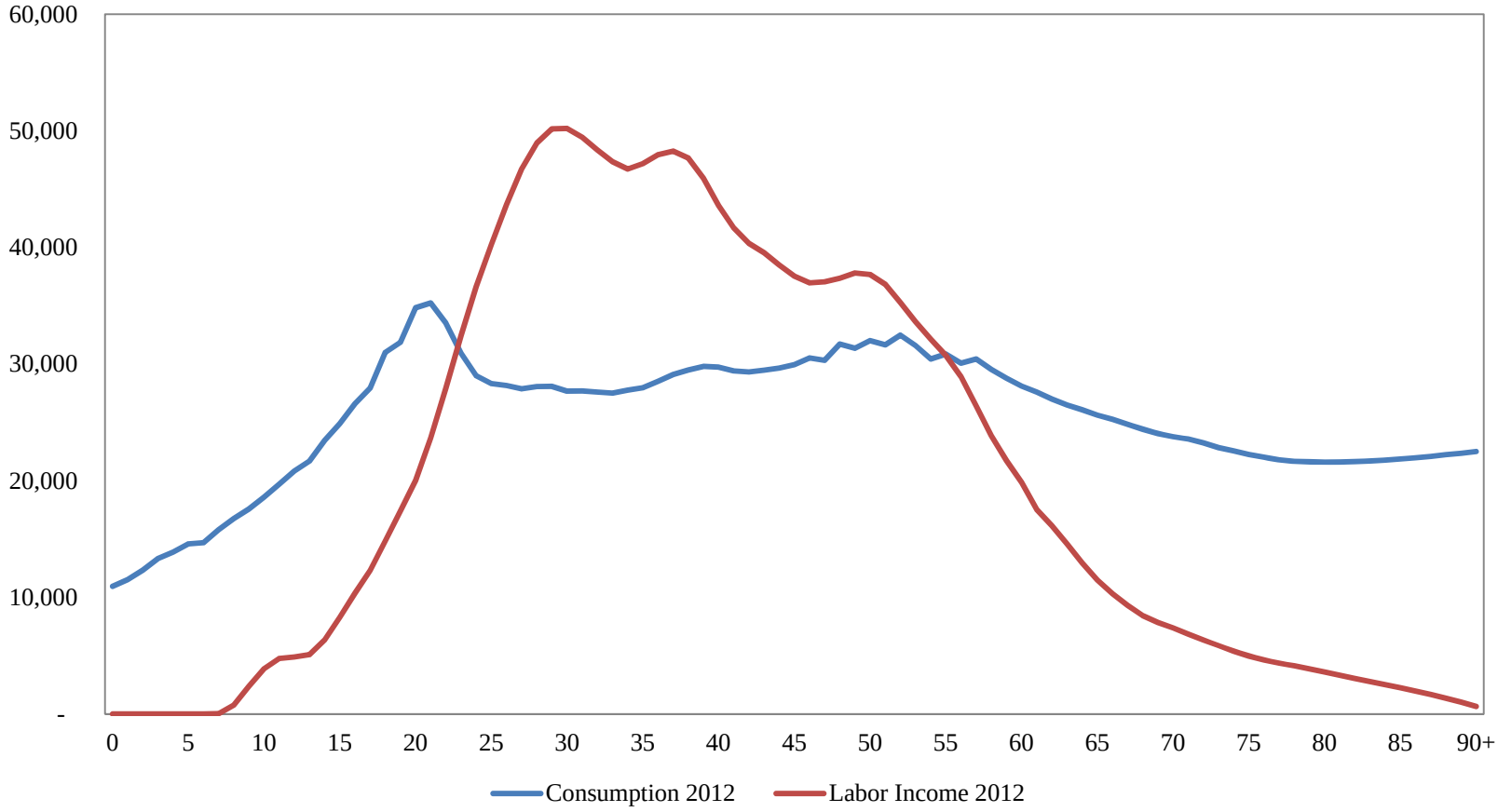
Fifth, changes in the population age structure will have a negative impact on total productivity, but changes in the productivity of each group will have a positive impact.

Figure 4. The contribution of age-group productivity change and population age structure change to national labor productivity, 2009-2049



4. Update of NTA model in Vietnam

Figure 5. Labor income and expenditure by age, 2012

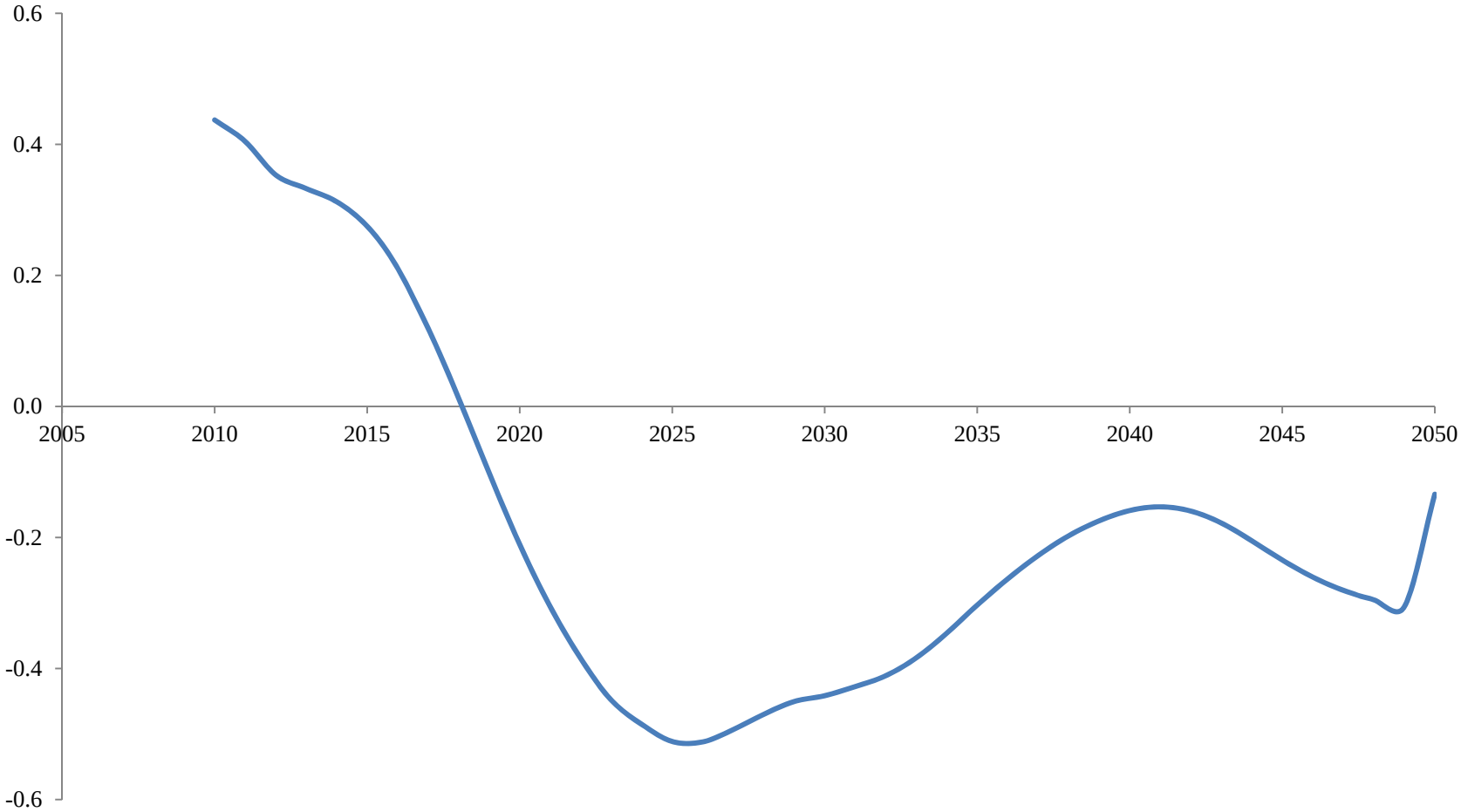


Source: Vietnam Household Standard of Living Survey, 2012

4. Update of NTA model in Vietnam

Fig. 6 Change in Vietnam's economic support ratio

Changes of population age structure will contribute positively to growth until 2019



5. Concluding Remarks

- The research indicates that population aging will have a significant impact on labor productivity
- Efficient utilization of labor by age will help to maximize workers' potential productivity
- In particular, we should provide young workers—the most productive age group—sufficient investment in education, health, skills, etc.
- Population will provide both opportunities and challenges for promoting economic growth and accumulation for the country

6. Discussion

- Research limitation :
  - Data only covers formal sector, not informal sector => built the weight for them to adjust productivity at each age group
  - The result depends on assumptions of change in productivity for each age group
- How to connect the productivity of each age group with the NTA model

THANK YOU FOR YOUR ATTENTION!