

Uzawa's growth theory and the neoclassical growth model essay

[Design](#)



Solow growth theory represent the relationship between technological change and growth where as the return falls, firms shift to more capital intensive production methods causing the investment to increase (2008). In order to achieve a model for describing the long-run evolution of the economy, this model ignores other important aspects of macroeconomics such as short-run rise and falls in employment and savings rates. Robert Solow developed this model in the 1950s and wrote A Contribution to the Theory of Economic Growth which provides a simple but dynamic model for a more advanced macroeconomic theory (Schlicht 2006). However, Hirofumi Uzawa introduced another economic model in the 1960s called the “ Uzawa Two-Sector Growth Model”; where this model is always stable given that the ‘ consumption-goods sector is more capital-intensive than the investment-goods sector’. This is qualitatively different from the Solow economic growth theory since its stability property solely depends on the causal property of technology (Fonsesca).

In 1956, Robert M. Solow and Trevor Swan proposed an economic growth model claiming that the capital-output ratio should not be regarded as exogenous as what the Harrod-Domar growth model stated. They introduced the “ Solow-Swan” model known also as the “ Neoclassical” growth model where the capital-output ratio (v) will be the adjusting variable to make s/v and the natural rate of growth (n) equal.

However, various economists have also proposed similar theory to the Solow-Swan model such as Jan Tinbergen in 1942, James Tobin in 1955, and Harold Pilvin in 1953. Tinbergen presented empirical estimates of the relevant coefficients in his model as effective as the Solow-Swan. Pilvin, on <https://assignbuster.com/uzawas-growth-theory-and-the-neoclassical-growth-model-essay/>

the other hand, had made an earlier argument regarding the Harrodian “knife-edge” problem. He argued that it can be resolved through the introduction of a flexible capital-output ratio, but he did not raise the issue of a steady-state. Tobin, just like Pilvin, he did not dwell into the concept of stability of the steady-state but the growth model that he introduced was similar to the Solow-Swan in the concept of money. Tobin's model then became the predecessor of theories on monetary growth (Fonseca).

In 1961, Hirofumi Uzawa introduced a two-sector extension of the Solow-Swan growth model which also encouraged a number of studies in the 1960s such as the Review of Economic Studies (Fonseca). The Uzawa model features two capital goods: physical capital and human capital. The physical capital is produced through consumption goods in the output using human and physical capital while the human capital is produced with physical and human capital in the education sector. The important factors that should be considered at any instant of time are: amount to be consumed, allocation of physical and human capital in the education sector, and the rate of physical and human capital to be accumulated. This model is characterized by transitional dynamics since it has two capital goods, but its analysis is limited to balanced-growth paths since it has been proved that endogenous growth in two-sector models is ‘intractable’ (Turnovsky 2000). Furthermore, Uzawa presented that Harrod neutral or purely labor-augmenting technological progress is required to achieve balanced growth (Schlicht 2006). The Uzawa-Lucas model has been a very significant endogenous growth model where steady-state growth rate of a general production of the physical capital can be derived and solve for the Cobb-Douglas production function.

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In this model, the production of human capital depends only on human capital while the production function of the physical capital is Cobb-Douglas. Various economists have made developments on the Uzawa-Lucas model such as Rebello in 1991 wherein he assumed that human and physical capital are used for the human capital production, explaining that the cross-country disparities in growth rates of outputs can be explained through the difference in government policies. Consequently in 1993, Mulligan and Sala-i-Martin dwell on the models' transitional dynamics arguing that Uzawa-Lucas model has an empirical imbalance effect to the human and physical capital. The output growth is depending on the ratio of human capital to physical capital (Duczynski 2005). In 2005, Duczynski presented equations relevant to the transitional dynamics and solved for the Cobb-Douglas production function. Aside from Cobb-Douglas, the proposition is by letting $Y = F(K, H)$ as constant-returns-to-scale (CRTS) where Y is output, K is physical capital, and H is human capital assuming that rates would be identical given Y , K , and H are at a constant growth rate. A CRTS function in any positive parameter satisfies $F(\lambda K, \lambda H) = \lambda F(K, H)$ and the Euler formula denoted by $Y = (\partial F/\partial K) K + (\partial F/\partial H) H$. In a steady state, the marginal products are intensive variables and required to be constant and Cobb-Douglas is the only CRTS function constant capital share.

On the other hand Xie presented that the two-sector model is capable of exhibiting multiple equilibria given the human capitals' large externalities (Duczynski 2005). In case of the absence of the externalities, the optimal growth and market equilibrium overlap ignoring the government intervention. However, the presence of externalities is not indisputable to

the government intervention since market failure is not associated with a sector-specific related to human capital because competitive equilibrium is optimal. A market failure might be affected by external factor such as human capital in goods sector where portion of capital accumulation might be lower than the optimal; causing the government intervention inducing agents for education to correct market failure (Gomez, Escalona et al.

2004). On the other hand, the Solow-Swan production function has been significant in analyzing the economic growth in developing countries since it allows for the substitution of capital and labor . The macroeconomic equilibrium condition where aggregate demand equal to the aggregate supply is represented by $Y_d = Y$ assuming that the investment savings is $I = S$. In the simplest consumption functions of $C = cY$, where c is marginal propensity to consume, savings become $S = Y - C = Y - cY$ or $S = (1 - c) Y$. Let $s = (1 - c)$ as the marginal propensity to save, to express savings as a proportion in the total output of $S = sY$ and combining this with the macroeconomic equilibrium condition $I = sY$. The amount of labor L in the economy will be divided: $I/L = s (Y/L)$ and letting $i = I/L$ and $y = Y/L$ and achieve the macroeconomic equilibrium condition as $i = sy$. The general production function of the aggregate supply denoted by $Y = F (K, L)$ is divided by L assuming that both K and L are constant returns to scale then, $Y/L = F (K/L, 1)$. This can be rewritten into $y = f (k)$ if $k = K/L$, where $f (\cdot)$ is the intensive form of the production function denoted by $F (\cdot)$.

The macroeconomic equilibrium then becomes $I = sf (k)$ and this could represent the actual investment per person assuming that $I = S$ always

(Fonseca). The neoclassical production function, unlike the Harrod-Domar model, has advanced discussions on the relationship between the capital accumulation, economic growth, and technology. The introduction of Solow-Swan model highlighted five important aspects: effect of investment ration on growth rate, relationship between share of capital and output elasticity, effect of capital and labor to income equilibrium, convergence of per capita income, and role of the technological development in productivity growth . The difference between Solow-Swan and Harrod-Domar are the different assumptions regarding the production function. Solow's findings in his 1957 report stating that only one-eighth of the growth output between 1909 to 1949, has encouraged various researches on growth policy and on other components of economic or noneconomic causes (Dixit 1990). In Solow-Swan, they identified technological progress as the factor that could sustain the income growth per capita, unlike in the Harrod-Domar model where engine development is the basis for the capital accumulation . The concept of the role of technology is one of the contributions of the Solow-Swan however this model failed to incorporate mechanisms on how to generate technological progress within the economy and treating the technology as exogenous. Solow concluded that machinery is not a source of growth in the long run, but instead the technological change that he based from the result of his calculations wherein seven-eighths of growth per worker in the United States is accounted from technological change.

In response to this, capital fundamentalists added that the fundamental determinant of growth is the increasing building and machinery . Dixit (1990) suggested changes in technology are relevant to explaining the low-

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frequency high period movements in output. Solow further concluded that savings cannot sustain growth and that high saving and low-saving economies are alike in sustained growth rate because it will divert money from consumption today into buying machinery for tomorrow's production. The high saving economy could have higher income than the low saving economy but the growth cannot be sustained due to diminishing returns. The diminishing returns depend on the role of capital in production. Capital fundamentalists argue that capital is very important for production, but Solow's assumption that building and machinery are just minor element in GDP becomes debatable.

According from Solow's calculations, capital income is just one-thirds of the US total income and the rest is wage income of workers. This conclusion becomes problematic especially in the sector of industrial economies wherein economic growth is already sustained at 2% per worker for many years. Solow's production implies that output growth per worker cannot be sustained and yet there is a sustained growth in industrial economies for two centuries . Moreover, the study growth and development of Cobb-Douglas as undertaken in the Uzawa model, which has input compose of physical and human capital, have not been highly questioned by researchers given that it is consistent one of Kaldor's stylized growth where there is a constant share of income accumulating to capital and labor. However, Solow argued that Kaldor's stylized fact is the factor shares which have been relatively constant for a short period of time and not that the factor share have been absolutely constant. He further added that slight change with Cobb-Douglas through the constant-elasticity-of-Substitution (CES) production technology will cause

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small trends in income factor shares. Hence, in studying the economic development process CES technology is satisfactory than Cobb-Douglas production function (Gomez, Escalona et al. 2004).

The further understanding the formal structure of Uzawa-Lucas model, Mattan (2004) explained the environment and technology based on the per-capita. A closed two-sector economic system is populated by a continuum similar to Barrotype infinitely-lived workers where a representative worker is provided with a unit of non-leisure time. Also, physical k_t and human capital h_t are under his control where time spent working u_t and complement $(1 - u_t)$ signifies time invested in learning given that identical competitive, atomistic firms pay rents and salaries.

Hence, final goods production is allocated to either consumption or investment obtained by combining human and physical capital. Mattana's (2004) per-capita version limits role of technological progress to inputs that cannot be accumulated such as raw labor. Cobb-Douglas is the production function where production in education sector is assumed through total non-leisure time. Production elasticities in physical capital and skilled labor assuming both are equal allows for constant-point-in-the-time technologies.

The perfect substitute for consumption would be the physical capital unless in the final goods sector since human capital cannot be substituted to the consumption. The two-sector growth model is relevant in explaining the real behavior of economies since different dynamics are analyzed where policies on economy can be derived. When the economy behave in situations that it

is not supposed to be resulting to imbalances, the predictions in the model can be significant.

The economy during transition is responding to the imbalances in a short-run. In optimal and equilibrium paths, the Uzawa-Lucas economy behaves such that the ratio of output and goods production is always greater than one, broad output and goods production grow at the similar rates, the rate of wage growth does not increase of the externality is at zero and decreases compare to the overall economy, the rate of savings cannot be constant but is positive, and the rate of interest is higher than the subjective discount rate and is constant (Mattana 2004). On the other hand, in comparison with the neoclassical model, Lucas argued that it cannot directly explain the case where capital does not flow to poor countries from the rich countries. He suggested three important aspects: differences in the human capital, external benefits in human capital, and imperfections in the capital market. Lucas has very well elaborated the Uzawa model where the two commodities are physical capital and human capital.

Human capital is attributed to the improvement of labor through various activities such as construction and maintenance of public goods and education health (Farmer and Lahiri 2004). In the Solow growth model however, despite its popular classical framework, has misrepresented the growth of technological progress which is a crucial element in the model. Technological progress is assumed to be exogenous or described as constant across countries. This assumption has overemphasized the factor accumulation and its role in explaining cross country income differentials.

The inaccurate assumption on the technological change resulted to the citing that the rate of conditional convergence is slower than Solow's prediction. Solow growth theory has been silent about the cross-country growth patterns after the predictions are laid down that the economy would converge with the value of the capital and output ratio being consistent with the steady-state growth where growth of output and capital have the same rates; and, that technological efficiency described to be exogenous would determine the growth rate of the steady-state path (McQuinn and Whelan 2006). The interpretation on the assumption that technology is exogenous is that total factor productivity (TFP) in all countries has the same exogenous growth rate and that fixed country-specific factors are the roots of TFP variations. The same assumption has contradicted the message of Solow model that the ultimate determinant of the output per worker growth rate is determined by technological progress since following that earlier assumption of similar TFP in countries would mean differences in the output per worker growth rates is determined by capital intensity. Many have adopted these assumptions however variance across counties in rates of growth output per worker has pointed to TFP differences among countries (McQuinn and Whelan 2006).

The inaccurate assumption on the technology has lead to rejection of the Solow model in various studies such that the model itself is failure. The model has also estimated slightly overlooked values of conditional convergence. Solow himself has rejected the assumption on technology undertaken by the MRW saying the questions might arise from this assumption but MRW argued that technology reflects a noncountry-specific factor which is the advancement of knowledge. However, this raises the

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question why the differences in TFP growth rates are not observed again since this happened in the past (McQuinn and Whelan 2006).