Residential Investment and Economic Growth

Yi Wen[*]

Economics Department
Cornell University
E-mail: yw57@cornell.edu

The causal relationship between growth and fixed capital formation is re-examined. Our findings are in sharp contrast with the earlier findings by Blomstrom et al. (1996) that capital formation does not contribute to economic growth. However, our findings also reject the conventional wisdom represented by De Long and Summers (1991, 1992) that capital formation in the form of business equipment determines the rate of a country's economic growth. What we have found instead is that capital formation in the residential sector (housing) causes GDP growth, which in turn causes capital formation in the business sector (plant and equipment). © 2001 Peking University Press

Key Words: Investment; Economic growth.
JEL Classification Numbers: E220, O400.

1. INTRODUCTION

This paper investigates whether household wealth accumulation (e.g., residential investment) is a significant contributor to economic growth. According to the conventional wisdom, fixed investment in non-residential sectors, such as business equipment investment, is the key to economic growth. For example, the strong relationship between fixed capital formation shares of GDP and growth rates since World War II has led De Long and Summers (1991, 1992) to conclude that the rate of capital formation in the form of equipment investment determines the rate of a country's economic growth. Yet, formal econometric tests under the Granger-Sims causality framework by Blomstrom *et al.* (1996) suggest that the direction of causality runs in the opposite way. Namely, it is the per capita GDP growth that leads to

rapid fixed capital formation in the economy. They thus suggest that the cause of economic growth ought to be found somewhere else outside capital accumulation, such as in institutions, economic and political climate, and economic policies that encourage education, inflows of foreign investment, lower population growth and so on.

In this paper we re-examine that issue by incorporating households' wealth accumulation into the framework. More specifically, we re-address the issue by decomposing aggregate fixed investment into its four components: non-residential investment in structures and equipment and residential investment in structures and equipment. The aim is to determine the robustness of the conclusions obtained by De Long and Summers (1991, 1992) and by Blomstrom *et al.* (1996), using an extended Granger-causality test, the block exogeneity test.

As was pointed out by De Long and Summers, if the components of aggregate fixed investment contribute differently to growth, then analyses of the relationship between total capital formation and growth are likely to be very misleading. But what the literature (including De Long and Summers) has failed to do is to differentiate residential investment from business investment. Casual observation suggests that residential capital formation might be an important contributor to economic growth for two major reasons. First, the majority of household savings are in forms of real estate, which accounts for the bulk of a nation's total wealth. Second, it is common to observe the leading role residential investment plays in business cycles. Namely, economic booms often follow real estate booms, and economic recessions are often related to slumps in the real estate sector.

Our results based on post-war U.S. data show that capital formation is indeed an important contributor to economic growth, as was claimed by De Long and Summers. However, it is capital formation in the household sector that unambiguously and unilaterally causes GDP growth, which in turn causes capital formation in the business sector.

Our analyses proceed as follows. In section 2, we show that GDP growth, while Granger-causing aggregate capital formation, is not exogenous with respect to sectorial capital formations as a block. In section 3 we further establish the causal links among GDP growth and capital formations in each individual sectors, and conclude that residential fixed investment in structures Granger-causes capital formation in the business sector as well as economic growth. Finally, in section 4 we offer some concluding remarks.

2. *GDP* GROWTH AND AGGREGATE CAPITAL FORMATION

We first estimate the following equations using total capital formation as a single variable as in Blomstrom *et al.* with our data set :

$$\Delta Y_t = f\left(\Delta Y_{t-1}, \Delta Y_{t-2}\right), \tag{1}$$

$$\Delta Y_t = f\left(\Delta Y_{t-1}, \Delta Y_{t-2}, INV_{t-1}\right); \tag{2}$$

where ΔY is growth in real income per capita, INV is the ratio of fixed capital formation to GDP, and t is the period of a quarter. Aggregate fixed investment is said to be Granger-causing growth when a prediction of growth on the basis of its past history can be improved by further taking into account the previous period's investment. Estimating (1) and (2) gives the following results ($t-$values are in parentheses):

$$\Delta Y_t = 0.645 - 0.00003t + 0.260\Delta Y_{t-1} + 0.100\Delta Y_{t-2}$$
$$\quad\ (6.4)\qquad (1.4)\qquad\quad (3.1)\qquad\qquad (1.2)$$
$$R^2 = 0.12 \tag{3}$$

$$\Delta Y_t = 0.634 - 0.00002t + 0.264\Delta Y_{t-1} + 0.116\Delta Y_{t-2} - 0.075INV_{t-1}$$
$$\quad\ (6.3)\qquad (0.8)\qquad\quad (3.1)\qquad\qquad (1.3)\qquad\qquad (0.8)$$
$$R^2 = 0.12 \tag{4}$$

Thus we reach the same conclusion as in Blomstrom *et al.* (1996) with our data set. Namely, we cannot reject the null hypothesis that aggregate capital formation in the preceding period has no explanatory power with respect to growth in the current period, given the past history of growth. The past history of growth is a poor predictor of current growth, but lagged investment does not improve the prediction.

For the reversed question, whether past growth has an effect on current capital formation rates given the history of capital formation rates, we obtained the following results that are also similar to those of Blomstrom et al.:

$$INV_t = 0.008 + 0.000007t + 1.323INV_{t-1} - 0.387INV_{t-2}$$
$$\quad\ (2.7)\qquad (1.2)\qquad\quad (16.9)\qquad\qquad (4.9)$$
$$R^2 = 0.94 \tag{5}$$

$$INV_t = -0.071 + 0.00001t + 1.19INV_{t-1} - 0.259INV_{t-2} + 0.080\Delta Y_{t-1}$$
$$\quad\ (3.2)\qquad (1.9)\qquad\quad (14.2)\qquad\qquad (3.1)\qquad\qquad (3.6)$$
$$R^2 = 0.95$$
$$\tag{6}$$

The t-statistic on ΔY_{t-1} in the second regression suggests that past growth has a significant effect on current capital formation even after past history of capital formation is taken into account. Even though the past history of capital formation rates predicts current rates well, past growth rates improve the prediction.

In sum, using our sample from the post-war U.S. economy, we have reconfirmed the results of Blomstrom *et al.* The causality seems to run in only one direction, from economic growth to capital formation.

However, results obtained using an aggregate variable may not be robust to the individual components in a regression where the aggregate variable is treated as a single variable instead of as a block variable. De Long and Summers (1991) have stressed particularly the importance of disaggregating investment in considering its relation to economic growth. For example, if we decompose aggregate fixed capital formation into its sectorial components, $INV = BST + BEQ + RST + REQ$, where BST and BEQ denote respectively the shares of non-residential structures and equipment investment to GDP, RST and REQ denote shares of residential structures and equipment (mainly furniture and kitchen appliances) investment to GDP. We then reestimate the following equation:

$$\Delta Y_t = f(\Delta Y_{t-1}, \Delta Y_{t-2}, BST_{t-1}, BEQ_{t-1}, RST_{t-1}, REQ_{t-1}), \quad (7)$$

then the following results are obtained (*t*-values are in parentheses):

$$
\begin{aligned}
\Delta Y_t = \quad &0.791 \quad + \quad 0.0003t \quad + \quad 0.167\Delta Y_{t-1} \quad + \quad 0.038\Delta Y_{t-2} \\
&(7.0) \qquad\qquad (2.2) \qquad\qquad (1.9) \qquad\qquad\qquad (0.4) \\
&+ 0.231 BST_{t-1} + 0.488 RST_{t-1} - 0.612 BEQ_{t-1} - \quad 15.87 REQ_{t-1} \\
&\;\;(0.8) \qquad\qquad\;\; (2.4) \qquad\qquad\;\; (2.3) \qquad\qquad\qquad (1.2) \\
&\hspace{8cm} R^2 = 0.19, F = 2.7
\end{aligned}
$$
$$\tag{8}$$

We see that once capital formation is disaggregated into its sectorial components, some of these components start to show significant effects on growth. The F-statistic for the null hypothesis that coefficients on all lagged capital formations as a block are zeros is significant at the 5% level. In particular, the significant t-statistics on RST_{t-1} and BEQ_{t-1} suggest that past investment in non-residential equipment and residential structures have significant effects on current growth even after the past history of growth is taken into account.

3. BLOCK EXOGENEITY TEST

This section formally investigates the causal links between growth and capital formation using block exogeneity tests. We first estimate the following VAR system:

$$X_t = f(X_{t-k}; k = 1, 2, 3, 4), \tag{9}$$

where X is a (5 x 1) vector consists of $\{\Delta Y, BST, BEQ, RST, REQ\}$. Table 1 summarizes the F-tests for the null hypothesis that all the coefficients on the distributed lag of a particular independent variable are zeros with respect to a particular dependent variable in a VAR system (including constant and trend terms). When the dependent variable is growth (ΔY), for example, we see that the only independent variable whose past history has significant effects on current GDP growth is residential capital formation on structures. The past history of growth as well as the past histories of other sectorial capital formations are not significant at all in explaining economic growth. On the other hand, when residential structural investment is the dependent variable, no histories of other variables in the VAR system has explanatory power on the current behavior of residential capital formation (RST). When business equipment investment is the dependent variable, in contrast, both GDP growth and residential capital formation (REQ) have significant predictive power even after past history of business investment is taken into account.

Over all, Table 1 helps to establish the following causal chains among economic growth and different forms of capital formation:

$$
\begin{pmatrix}
BST & \leftarrow & BEQ \\
 & \nearrow & \\
 & \Delta Y & \uparrow \\
 & \nearrow & \\
RST & \rightarrow & REQ
\end{pmatrix}
\tag{10}
$$
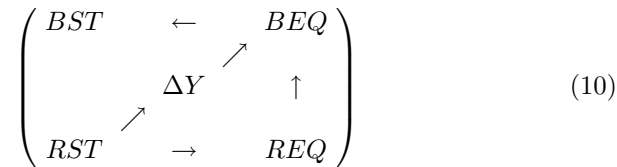
In this Granger-causal network, investment in residential structures (RST) is the source of growth (ΔY), while investment in business equipment and structure (BST and BEQ) is the consequence of growth.

To establish further the robustness of the finding that residential capital formation in housing is the source of economic growth (as well as capital formation in the business sector), we estimate the following equations:

$$RST_t = f(RST_{t-k}, B_{t-k}; k = 1, 2, 3, 4), \tag{11}$$

$$B_t = f(B_{t-k}, RST_{t-k}; k = 1, 2, 3, 4), \tag{12}$$

TABLE 1.

F-Statistics for Quarterly Data

Dependent Variable ΔY		
Variable	F-Statistic	Significance Level
ΔY	0.0369	0.9974
BST	0.5866	0.6729
RST	5.1999	0.0007
BEQ	1.4410	0.2248
REQ	0.3334	0.8550
Dependent Variable BST		
Variable	F-Statistic	Significance Level
ΔY	0.7915	0.5330
BST	290.58	0.0000
RST	2.0584	0.0907
BEQ	3.0364	0.0201
REQ	1.9945	0.0999
Dependent Variable RST		
Variable	F-Statistic	Significance Level
ΔY	0.3415	0.8495
BST	1.3163	0.2680
RST	108.15	0.0000
BEQ	0.2940	0.8814
REQ	0.5273	0.7159
Dependent Variable BEQ		
Variable	F-Statistic	Significance Level
ΔY	4.0089	0.0044
BST	1.4107	0.2347
RST	0.9219	0.4537
BEQ	175.96	0.0000
REQ	2.9206	0.0241
Dependent Variable REQ		
Variable	F-Statistic	Significance Level
ΔY	1.8366	0.1264
BST	1.2949	0.2761
RST	6.7161	0.0001
BEQ	1.4165	0.2328
REQ	161.99	0.0000

where B is a block variable that consists of $\{\Delta Y, BST, BEQ, REQ\}$. In equation (11), we test the null hypothesis that the past histories of B as a block have no explanatory power with respect to capital formation in residential structures (RST) given the past history of residential investment. The F statistic is 1.05 with significance level 0.41. So the null hypothesis cannot be rejected.

In equation (12), we test the null hypothesis that the past history of residential capital formation in terms of structures has no explanatory power on the current behavior of B as a block given the past histories of B. The chi-squared test statistic is 53.1 with significance level 0.000007. So the null hypothesis is strongly rejected.

To check the robustness of the above results even further, we have also repeated all of the above exercises using different VAR lag specifications (e.g., from VAR(2) to VAR(8)), different data frequencies (e.g., from quarterly frequency to annual frequency and even 5-year frequency), and different variable specifications (e.g., using growth rates for capital formation instead of the ratios of capital formation to GDP), and we obtained very similar results.

4. CONCLUDING REMARKS

This paper has re-examined the relationship between capital formation and economic growth. According to the traditional view expressed in De Long and Summers (1991 and 1992), fixed investment in non-residential sectors, especially in equipment investment, is the key to economic growth. Blomstrom *et al.* (1996), however, showed that the causal link between growth and investment runs in the opposite direction. They thus suggested that the source of economic growth ought to be found some where else outside capital accumulation. Our findings in this paper do not conform to either of these views about the cause of economic growth. What we have found, surprisingly, is that capital formation in the residential sector Granger-causes economic growth, which in turn Granger-causes capital formation in the business sector. This perhaps explains the slow down of U.S. economic growth for the 80s and the early 90s, because residential investment as shares of GDP has been falling while non-residential investment as share of GDP has been rising during that period.

These findings raise a number of questions analogous to those raised by De Long and Summers (1991). First can they be reconciled with earlier research, especially research downplaying the role of residential capital accumulation? We believe that many previous studies have been carried out at an inappropriate level of aggregation. We are not aware of previous work that has separated the components of aggregate investment into residential and non-residential investment and studied their differential impacts

on growth. Given the clear differences in the composition of aggregate investment, it is not surprising that studies that have focused on either total capital accumulation (such as Blomstrom et al.) or on non-residential capital formation (such as De Long and Summers) have understated the potential contribution of residential investment to GDP growth.

Second, are our results an artifact of the particular data set we have studied? We have examined growth and residential investment during the post-World War II period for the U.S., a period that contains the largest residential housing boom and recession in a developed economy. Would residential investment also be strongly linked to economic growth for other nations, especially the developing countries, and other episodes of economic history?

Third, although it has long been known that housing construction is a leading indicator of business cycles, a time series leading another does not at all imply Granger causality. The true question therefore is, why and how does residential investment contributes to growth? Presumably some important input-output linkages operate. But, at the present, we have little insight into exactly what they are, or what their relative quantitative importance is.

If our findings based on the U.S. data are universal to both developed and developing countries, then the current understanding on the engine of economic growth is incomplete and ought to be revised. Theoretically speaking, the neo-classical growth model needs to be modified to incorporate residential capital formation; empirically speaking, polices devoted to economic growth need to be re-examined, and special attention needs to be paid to the real estate sector in terms of tax laws that affect individual incentives for residential investment.

A final caveat is this: if consumption not only is the ultimate goal of production but also provides the single most important stimulus to economic growth, then demand for housing, which accounts for the largest fraction of total household spending, should not be ignored by any government that strives for economic growth and development in both the short and the long run.

REFERENCES

Blomstrom, M., R. E. Lipsey, and M. Zejan, 1996, Is fixed investment the key to economic growth? *Quarterly Journal of Economics* February, 269-276.

De Long, J. B. and L. Summers, 1991, Equipment investment and economic growth. *Quarterly Journal of Economics* **CVI** 445-502.

De Long, J. B. and L. Summers, 1992, Equipment investment and economic growth: How strong is the nexus? *Brookings Papers on Economic Activity*, 157-211.