Monetary Policy and Intangible Investment

By Cooper Howes and Alice von Ende-Becker

Prior to 1980, about 90 percent of investment in the United States was in "tangible" physical capital goods such as airplanes or office buildings. But over the past four decades, the share of business investment in non-physical or "intangible" goods, such as software or research and development (R&D), has tripled; currently, intangible products account for almost 30 percent of all investment spending.

This shift in the composition of investment may have important implications for monetary policy. Interest rates have historically been a crucial tool through which policymakers affect firms' investment behavior. However, Döttling and Ratnovski (2021) suggest intangible investment is far less sensitive than tangible investment to changes in interest rates, both because intangible investment is less likely to be financed through bank loans and because intangible goods have a shorter useful lifespan. As a result, monetary policy could become less effective as intangible investment continues to gain prominence in the economy.

In this article, we provide a simple framework to explain how the financing structure and depreciation rate of intangible investment cause it to respond differently to changes in interest rates and then analyze what these properties imply for the efficacy of monetary policy. Our framework, which builds on the findings of Döttling and Ratnovski (2021), highlights that monetary policymakers may need to adjust their

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approach to managing the economy as the share of intangible investment continues to grow.

Section I documents the rise in intangible investment. Section II highlights research that suggests that the rise in intangible investment has made the economy less responsive to monetary policy. Section III establishes a simple framework for understanding how an asset's financing structure and longevity affect its sensitivity to changes in interest rates.

I. The Rise of Intangible Investment

Several different types of investment factor into calculations of GDP. In this paper, we focus on productivity-enhancing business expenditures, such as a mixer for a bakery, sales software for a retailer, or a warehouse for a delivery company. This type of expenditure is classified by the U.S. Bureau of Economic Analysis (BEA) as nonresidential fixed investment. As shown in Figure 1, nonresidential fixed investment accounts for roughly three-quarters of all fixed investment, with housing (residential investment) accounting for the remaining share.[1]

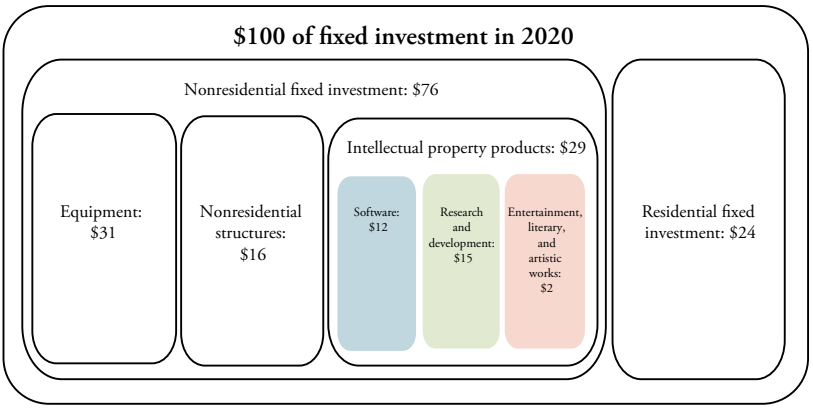
The inclusion of intangible intellectual property products such as software in these calculations is a relatively recent development. Until the late 1990s, the BEA limited its definition of nonresidential fixed investment to two categories: equipment and structures. In 1999, recognizing that technological developments had increased the importance of intangible investment, the BEA created a third category of nonresidential fixed investment—intellectual property products—and released retroactive estimates for these products as far back as 1929.

This category includes software, R&D, and entertainment, literary, and artistic works. Throughout this article, we follow the BEA and use these three groups as our definition of intangible investment.[2] As Chart 1 shows, the share of investment coming from these intangible products has increased steadily over the past four decades, from about 10 percent in 1980 to almost 30 percent in 2020.

The rising investment share in part reflects the rapid growth of the information technology and professional service sectors, which tend to rely more on intellectual property products. The share of investment in the professional and information services sectors rose by almost 8 percentage points from 1980 to 2020, with similar increases in the shares of employment (5 percentage points) and GDP (9 percentage points)

Figure 1

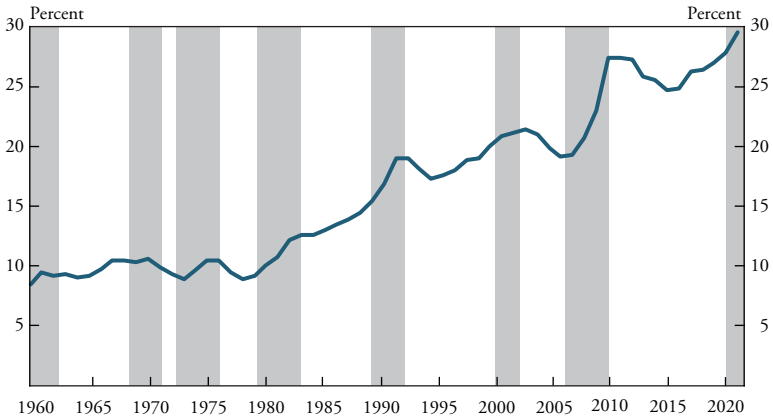
Breakdown of $100 Fixed Investment in 2020



Source: BEA.

Chart 1

Share of Intangible Investment in Total Nonresidential Fixed Investment, 1960–2020



Note: Gray bars indicate National Bureau of Economic Research (NBER)-defined recessions.
Sources: BEA and NBER.

coming from these sectors. For context, this increase in the investment share for intangible producers is larger than the 2020 investment shares for the agriculture, mining, and construction sectors combined.

However, much of the increase in intangible investment has also come from changes *within* industries over time. Table 1 shows the changes in intangible investment shares across sectors. Much of the growth over the past few decades has come from sectors that previously did not

Table 1
Changes in Shares of Intangible Investment across Sectors, 1960–2020

	Intangible investment share (percent)				
Sector	1960	1980	2000	2020	Total change
Mining	0.0	0.9	8.5	8.8	8.8
Construction	0.0	0.0	7.2	11.9	11.9
Manufacturing	30.9	30.1	49.4	62.3	31.5
Wholesale trade	0.0	2.3	19.3	36.9	36.9
Retail trade	0.0	2.1	10.1	28.6	28.6
Transportation	0.0	0.8	8.2	8.8	8.8
Information	29.8	24.3	41.1	58.8	29.0
Finance, insurance, and real estate	0.0	10.5	22.5	48.9	48.9
Professional and business services	25.0	45.8	58.4	68.6	43.6
Educational services	0.0	10.7	14.8	36.9	36.9
Health care	0.0	4.1	9.0	14.0	14.0
Total	8.6	10.2	20.9	29.6	21.0

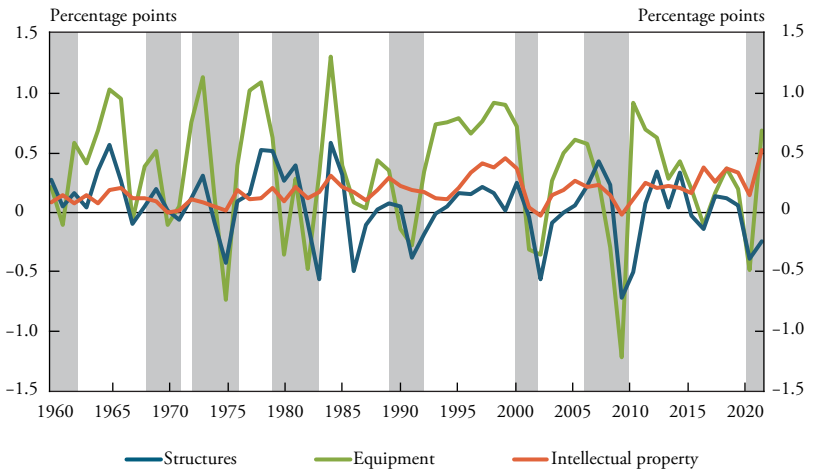
Source: BEA.

have sizable intangible investment shares. For example, industries such as wholesale trade and retail trade, which have historically used almost exclusively physical assets, now have more than one-third (36.9 percent) and one-quarter (28.6 percent) of their investment, respectively, in intangibles. In other words, while the greater role of intangible investment since 1980 has been driven in part by the rise of companies like Amazon and Google, much of the change has also come from retailers, manufacturers, schools, and hospitals modernizing their operations.

These changes have helped reduce volatility in economic activity. Chart 2, which plots the contribution of each category of investment to real GDP growth over time, shows that intangible investment (orange line) tends to provide a much more stable contribution to real GDP growth than equipment (green line) or structures (blue line). Even during the depths of the Great Recession, when equipment and structures combined to depress real GDP growth by two percentage points, intangible investment dampened GDP growth by only –0.02 percentage points.

Intangible investment in most sectors is likely to continue increasing in the future. Although reduced investment volatility may help smooth business cycles and contribute to a more stable economy, the

Chart 2
Investment Contribution to Real GDP Growth, 1960–2020



Note: Gray bars indicate NBER-defined recessions.
Sources: BEA and NBER.

increased stability from intangible investment may come with costs for monetary policymakers.

II. Understanding the Effects of Intangible Investment on Monetary Policy

Traditionally, central banks have attempted to influence investment activity through changes in interest rates. As a result, changes in the characteristics of investment could alter the transmission of interest rate policy to economic activity. Given these concerns, many academic researchers have studied the rise of intangible investment and how it might affect monetary policy.

Research has consistently found that a greater share of intangible investment reduces monetary policymakers' influence on investment activity. Döttling and Ratnovski (2021) show that aggregate tangible investment declines by up to 3 percent in the three years following a contractionary monetary policy shock, while intangible investment declines just 1 percent in response to the same shock.[3] When they look at firm-level data, they find an even starker difference: tangible investment rates for the average firm fall by up to 6 percent in response to a contractionary monetary policy shock, while intangible investment rates decline by just 1 percent. As the share of intangible investment

continues to grow, central banks may have greater difficulty stimulating economic activity during downturns or reining in inflationary pressures during expansions.

What makes intangible investment less responsive to monetary policy? To answer this question, we develop a simple framework to illustrate how investment responds to changes in interest rates. Although our approach is far simpler than the models used in academic papers, it highlights the same fundamental channels that drive the results documented by Döttling and Ratnovski (2021). In addition, our approach highlights the implications for central banks operating in a world with a large and growing share of intangible investment.

A theory of investment

Investment is unique relative to other types of expenditures because it can have effects on production long after the initial purchase is made. For example, a firm might decide to purchase a new office building if they expect business to pick up in the coming years even if their current sales are slow. In contrast, the decision to purchase office supplies such as pens or paper is much more likely to be based on short-term needs. This means that investment decisions must often take a much wider range of factors into account than other purchases.

Many of the considerations influencing investment decisions can be summarized by a single measure known as the *user cost of capital* (Jorgensen 1963; Hall and Jorgensen 1967). A profit-maximizing firm will choose to invest if the user cost of an investment good is less than or equal to the additional revenue it provides—the marginal product of capital. Holding all else equal, if the user cost of an investment good increases, it needs to have a higher marginal product of capital to break even, and thus investment will fall. If the user cost decreases, the threshold required for an investment project to be profitable will decrease, and investment will rise. In this sense, the user cost of capital can be thought of as the true "price" of investment for a firm.

In its simplest form, the user cost can be expressed as the sum of the firms' financing costs and the investment good's depreciation rate.[4] Changes in either of these variables will affect firms' investment decisions. For example, higher financing costs act as an additional outlay that must be paid each period that the investment good is in use, making investment less appealing when financing is more expensive. Similarly, a slower depreciation rate means that a smaller share of the invest-

ment good breaks down in each period, and thus the good will provide value further in the future. This relationship suggests that investment goods with shorter lifespans need to be either cheaper or more useful.

The effects of monetary policy on investment

Because the central bank conducts monetary policy primarily through changes in interest rates, the degree to which monetary policy will affect a particular investment good will depend on how responsive that investment good's financing costs are to changes in interest rates. If firms rely more on investment goods whose financing costs are less sensitive to interest rates, then changes in monetary policy will have a smaller effect on investment.

To illustrate this relationship, we highlight two extreme examples. First, consider a firm that finances the entirety of its investment with bank debt. The financing cost of debt is simply the interest rate on that debt, so as the central bank raises interest rates, the firm's financing expenses will increase one-for-one. In contrast, consider a second firm that does not have access to bank loans and must instead finance all investment expenditure through its own cash holdings. Changes in interest rates will have a much smaller effect on this firm because it is not borrowing. In reality, most firms rely on a wide range of financing sources and are likely to fall between these two extremes, but these examples highlight why greater reliance on bank debt can make a firm's investment decisions more sensitive to monetary policy.

In contrast to financing costs, which depend on interest rates and can thus be directly affected by monetary policy, depreciation is a fundamental property of an investment good and does not respond to changes in interest rates. However, depreciation rates can still affect the transmission of monetary policy because the *percentage change* in the user cost, rather than its level, is what determines the magnitude of investment responses to changes in the user cost. Just as saving $1 on a gallon of gasoline will have a far bigger effect on demand than saving $1 on a house, a reduction in financing costs for an investment good with a high depreciation rate will have a much smaller effect on investment demand than a good with a low depreciation rate.

Table 2 offers several numerical examples of how the user cost of capital determines how interest rates affect investment. For example, if

Table 2

Financing and Depreciation Influence How Interest Rates Affect Investment

Financing cost (percent)	Depreciation rate (percent)	Total user cost (percent)	Percent change in user cost from a 1 percentage point increase in the interest rate
r	δ	$r + \delta$	$\frac{1}{r+\delta}$
5	3	8	$\frac{1}{8} = 12.5$
5	10	15	$\frac{1}{15} = 6.7$
5	25	30	$\frac{1}{30} = 0.3$

a firm pays a 5 percent annual interest rate on an investment good that depreciates at a rate of 10 percent per year, then the user cost will be 15 percent. If the interest rate were to increase by 1 percentage point, the new user cost would be 16 percent, which would represent a 6.7 percent increase from its original level. If the depreciation rate increases to 25 percent per year, then the user cost would increase to 30 percent, and the same 1 percentage point increase in the interest rate would only raise the user cost by 0.3 percent.

The user cost of capital, expressed as the sum of an investment's financing costs and its depreciation rate, thus illustrates how monetary policy transmits to investment. Investment is less sensitive to changes in monetary policy if it depends less on bank debt and has higher depreciation rates—two properties of intangible investment.

III. Intangibles and the Transmission of Monetary Policy

As noted in the previous section, Döttling and Ratnovski (2021) find that intangible investment is between one-third and one-sixth as responsive to monetary policy compared with tangible investment. The authors test several channels and conclude that their empirical findings can primarily be explained by differences in financing costs and depreciation rates. In this section, we incorporate BEA data on intangible

investment into our user cost framework to show where these results come from.

First, we consider financing costs. Researchers have found that intangible investment is less likely to be financed through bank loans and more likely to be financed through firms' cash holdings.[5] This tendency largely reflects that many bank loans require collateral. If banks know that they can seize an asset in the event the borrower cannot repay the loan, they will be more likely to extend credit. Just as many homeowners are only able to borrow the funds to buy a house by pledging the house as collateral, many firms fund purchases of investment goods through loans that pledge them as collateral.

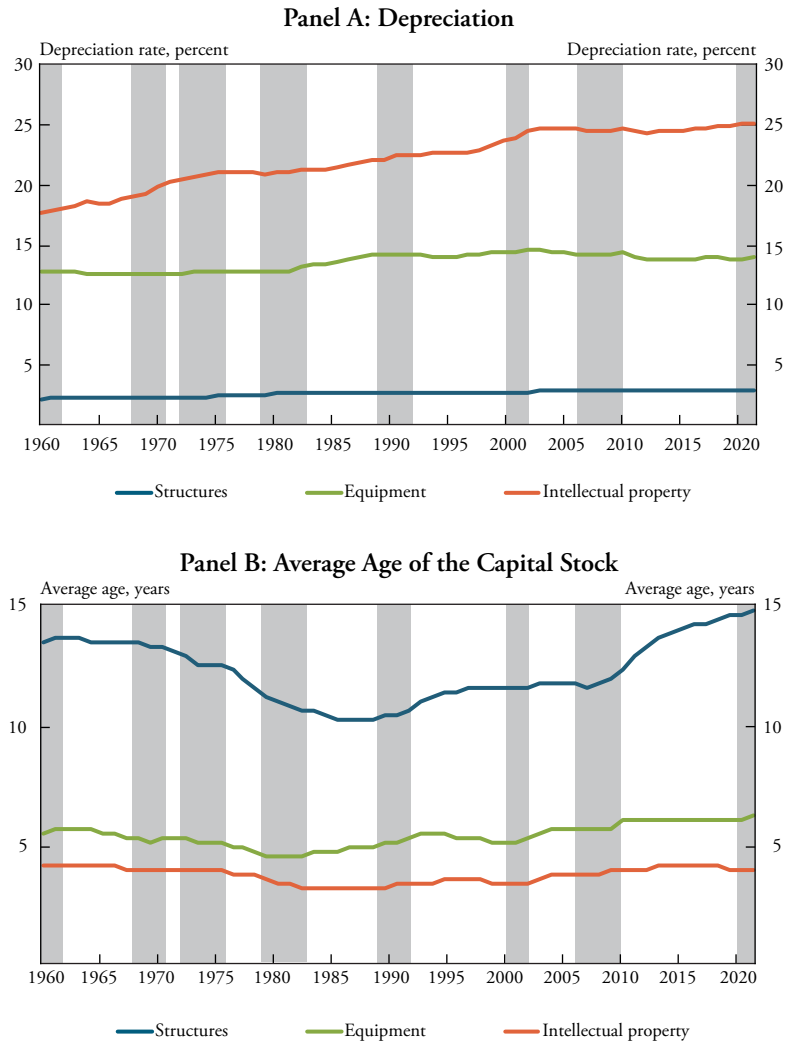
Intangible investment, unlike equipment or structures, is generally not useful as collateral because it is likely to have a lower resale value. If a manufacturer defaults on the loan collateralized by an office building, the bank knows that it can sell the building to a law firm or technology company because a wide range of industries require offices. In contrast, a custom piece of software written for a manufacturing firm may not be useful to other firms even within the same narrow industry. This specificity can explain why firms are more likely to fund intangible investments through internal cash holdings. Because the financing costs of investments funded through bank loans will be more responsive to changes in interest rates than investments funded through internal cash holdings, this channel can help explain why intangible investment is less responsive to monetary policy.

Another distinguishing feature of intangible investment that affects its sensitivity to monetary policy is its faster depreciation rate. Panel A of Chart 3 shows the BEA's annual depreciation rates for equipment, structures, and intellectual property. Approximately 13 percent of the value of the stock of equipment (green line) depreciates per year, as machines break down or become obsolete over time. This number is even lower for structures (blue line), which depreciate at a rate of about 3 percent per year. In contrast, intangible investment—which does not deteriorate physically, but can lose its usefulness as new and improved software is released or research becomes outdated—currently depreciates at a rate of about 24 percent per year (orange line).

Panel B of Chart 3 shows that the average age of the capital stock of both structures (14 years) and equipment (seven years) are higher than for intellectual property (four years). Because investments with

Chart 3

Depreciation Rates and Average Age of Investment by Category, 1960–2020



Note: Gray bars indicate NBER-defined recessions.
Sources: BEA and NBER.

shorter lifespans tend to be repaid over shorter periods, the durability of an investment can affect its sensitivity to interest rates. Because the depreciation rate represents the fraction of an investment good that deteriorates each period, investments with shorter lifespans will have higher depreciation rates. As we showed in the previous section, a higher depreciation rate means that changes in interest rates will have a proportionately smaller effect on the user cost, and as a result investment goods with higher depreciation rates will be less sensitive to monetary policy.

Conclusion

The effect of interest rates on investment activity is one of the primary channels through which monetary policy affects the broader economy. Since 1980, however, the nature of investment has changed significantly, with almost one-third of investment now consisting of intangible products. Researchers have argued that this shift has made the economy less sensitive to monetary policy. We illustrate why the reduced interest rate sensitivity of intangible investment is a natural consequence of its lower reliance on bank financing and higher depreciation rates. Going forward, understanding the unique properties of intangible investment will be crucial for the effective conduct of monetary policy in an increasingly intangible economy.

Endnotes

[1]The BEA defines total investment as fixed investment plus changes in private inventories, which we do not consider in this paper.

[2]A more general definition of investment could include any expenditure today that increases production in the future. This would cover many other intangible assets such as brand loyalty, marketing, or institutional knowledge. Although our empirical analysis focuses on the narrower definition of intangible investment used by the BEA, in principle all our main findings should also apply to these broader categories.

[3]Other examples of papers that analyze the implications of intangible investment include Falato and others (2020), Caggese and Perez-Orive (2021), and Crouzet and Eberly (2021).

[4]In general, the user cost is a complicated object that is derived from a model and will thus change depending on the specific model being considered. With perfect liquidity, no adjustment costs, and constant prices for the investment good, the user cost can be expressed as described in the text: $UC = \delta + r$, where δ is the depreciation rate and r is the interest rate. For many more complex models, however, it is not possible to derive closed-form expressions for the user cost.

[5]Hall and Lerner (2010) analyze empirical patterns in financing arrangements for intangible investment and argue that firms tend to rely on internal funds for these expenditures. More recent work, including Li (2020) and Falato and others (2021), shows that firms that rely more on intangible investment hold more cash and use less debt, making their financing costs less sensitive to changes in interest rates. Hall and Lerner (2010) also argue that small firms, which do not have access to the same levels of internal funds as large firms, are able to offset some of these financial frictions using venture capital but emphasize that it cannot completely close this financing gap. While past work such as Gompers and others (1998) and Romain and van Pottelsberghe (2004) suggests that macroeconomic factors can matter for venture capital markets, very little is known about the ability of monetary policy to influence these markets at the business-cycle frequency.

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