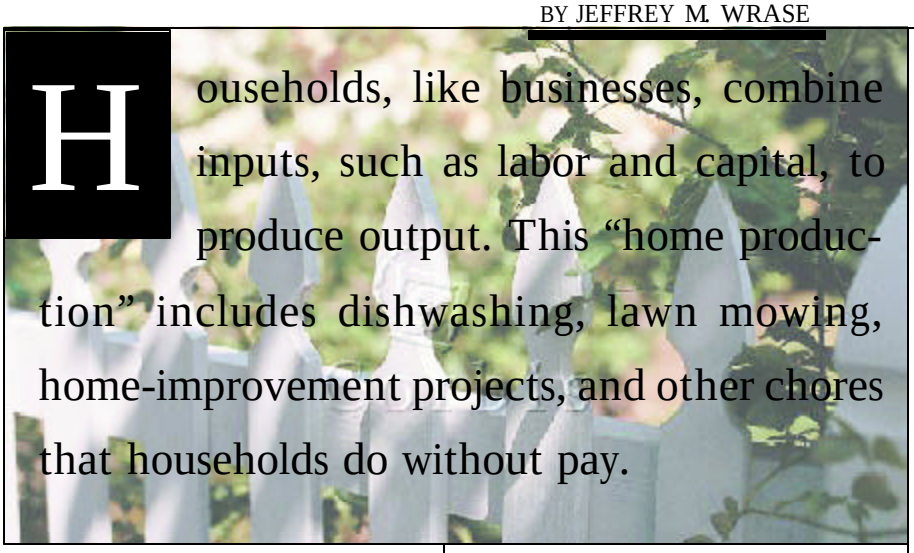
The Interplay Between Home Production And Business Activity

BY JEFFREY M. WRASE



Households, like businesses, combine inputs, such as labor and capital, to produce output. This "home production" includes dishwashing, lawn mowing, home-improvement projects, and other chores that households do without pay.

Although decisions households make about the amount of time and resources to devote to home production versus working in the marketplace influence official measures of economic conditions, these measures don't take home production into account.

Models of economic activity usually ignore home production as well. In fact, research on home production shows that the variability of many key macroeconomic variables, as well as how those variables respond to changes in the economic environment, may be skewed because the typical macroeconomic model does not fully account for how people allocate time and resources between market activity and other activities. Analysts, forecasters, and policymakers could benefit from economic models that incorporate such decisions.

This article explores how home production influences official measures of the economy.[1] It also discusses the potential gains from incorporating household decisions about allocating resources to home production into models used to forecast and to account for changes in economic conditions.

HOME PRODUCTION AND ECONOMIC MEASUREMENT

Most people are familiar with headlines describing how fast or slow the economy's growth is, and many measures of growth are based on government statistics that gauge the total value of output produced in the economy. A substantial amount of the output captured by those statistics is devoted to goods and services *used* by households. However, some output, such as that *produced* by households, is not counted in official measures of economic activity.

How Much Home Production Takes Place in the Economy? Because official measures of economic activity do not explicitly include home production, it is not easy to say how much takes place at any point in time or how such production changes over time. Some economists have, however, attempted to measure home production and other nonmarket activity.[2] Others have studied how households divide their available time across alternative activities, such as market work and home production.[3]

We can gauge the magnitude of home production in two ways. One involves looking at the amount of time people devote to unpaid work at home. Thomas Juster, Frank Stafford, and Martha Hill have produced extensive research studies of how households use their time. Their studies use a number of sources, including an extensive database compiled by the Institute for Social Research at the University of Michigan, called the Michigan Time Use

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[1] Official measures refer to economic data produced by various statistical agencies, including the Bureau of Economic Analysis, Bureau of Labor Statistics, and the U.S. Department of Commerce. The data are available on the agencies' web sites or in various documents, such as the Federal Reserve Bulletin, the Survey of Current Business, or the Economic Report of the President.

[2] See the articles by Robert Eisner and the article by William Nordhaus and James Tobin.

[3] See the article by Thomas Juster and Frank Stafford and the one by Martha Hill.

Survey. This survey contains data on individuals' allocations of time to various activities during each day, based on extremely detailed diaries kept by respondents for one year.

According to these time-use surveys, a married couple, on average, devotes 25 percent of discretionary time to unpaid — and not officially measured — home production such as child care, cooking, and cleaning, and 33 percent of discretionary time to work in the marketplace for pay.[4] By this measure, home production is indeed significant.

Another way to gauge home production is to look at inputs and outputs. On the input side, economists Jeremy Greenwood, Richard Rogerson, and Randall Wright (1995) examined data from the U.S. national income and product accounts. They found that *household capital investment*, defined as purchases of residential structures and consumer durable goods, *exceeds business capital investment*, defined as purchases of nonresidential structures and producer durable goods.

On the output side, another economist, Robert Eisner (1988), reported that the value of home production could range between 20 percent and 50 percent of the value of the U.S. economy's output, officially measured as gross domestic product (GDP).[5] And with GDP currently around $10 trillion, 20 to 50 percent is a lot of unmeasured output.

Thus, all the measures above indicate that home production amounts to a significant portion of activity that is not explicitly picked up in official measures of the economy's performance. Furthermore, most macroeconomic models have little to say about it.[6] To better explain movements in official measures of economic variables, models need to account for the way inputs into home production and the resulting output change from period to period. We each have a fixed amount of time available each day, and we divide it among market production, home production, and leisure.[7] Accordingly, changes in home production over time will lead to changes in time allocated to economic activity picked up by official measures.

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WHY ARE THERE FLUCTUATIONS IN MACROECONOMIC ACTIVITY?

What fundamental forces drive business cycles?[8] And why do households devote more time to working in the marketplace during expansions and less time during recessions? Many possible answers to these basic macroeconomic questions have been put forth.

One answer emphasizes that macroeconomic fluctuations arise from the sometimes unintended consequences of economic policies, including changes in taxes or government expenditures, changes in regulations imposed on firms, or changes in the money supply. For example, an increase in taxes may slow the demand for goods by households and firms. The slowdown in demand could then lead to layoffs and, consequently, reduced time devoted by households to working in the marketplace. A major difficulty with this explanation is that it is hard to establish statistically a causal link between changes in economic policies and macroeconomic fluctuations.

Another answer proposes that the economy fluctuates between periods of expansion and contraction because of inexplicable shifts in consumers' preferences, in the preferences of firms that invest in goods to use in producing other goods, or in the preferences of savers, who supply funding for consumers and firms. Such shifts in preferences, sometimes called changes in consumer or investor optimism, or "animal spirits," could also lead to changes in overall demand for goods and, consequently, to changes in the amount of time that people devote to working in the market. The problem with this explanation of business cycles lies in the difficulty of obtaining convincing measures of preference shifts.

[4] Discretionary time refers to time not spent sleeping or on personal maintenance.

[5] GDP is the current market value of all final goods and services produced in a period by domestically owned factors of production.

[6] The idea of incorporating home production into economic models — or, more particularly, households' time-allocation decisions between activities other than simply leisure or work in the marketplace — is not new. Labor economists have included home production in models of the labor market for decades — at least as early as 1965 (see Gary Becker's article). But the relevance of home production and attention to households' time-allocation decisions across a variety of possible activities have only recently been considered in research into factors contributing to fluctuations in economic activity.

[7] Leisure includes time spent sleeping and on personal maintenance.

[8] Broadly defined, business cycles, also called macroeconomic fluctuations, are alternating periods of expansion and contraction of economic activity.

In the past 20 years, another answer has gained a lot of attention: fluctuations arise as a consequence of random shifts in technologies used by firms to produce goods and services. Specifically, these random shifts alter the effectiveness of inputs in producing output. For example, a technological change may mean that a given amount of labor, when combined with other inputs, can produce more output than before. Such changes in the productivity of labor, in turn, could lead to changes in the amount of labor that firms want to hire and perhaps the amount of time that households wish to supply to firms in the marketplace. So, random shifts in productivity — also called productivity shocks or technology shocks — can spark changes in employment, GDP, and other key variables. (See *How Important Are Technology Shocks for Growth and Fluctuations in Macroeconomic Activity?*)

TYPICAL MACROECONOMIC MODEL

Most macroeconomic models attempt to account for changes in the amount of time devoted to market work over a business cycle by assuming that households devote time either to

How Important Are Technology Shocks for Growth and Fluctuations in Macroeconomic Activity?

Nobel laureate Robert Solow calculated the sources of long-term economic growth, using what is known as the neoclassical growth model of the economy, based on data for the period 1909 to 1949.* His estimates revealed that changes in productivity accounted for 87.5 percent of the growth of output per worker and increased capital per worker accounted for 12.5 percent. Thus, during the period Solow studied, most of the growth of output per worker was due to improvements in productivity.

Updating Solow's estimates of the sources of growth using data from the mid 1950s to the early 1990s, Thomas Cooley and Edward Prescott obtained results similar to Solow's: the majority of growth in output per worker in the U.S. economy stems from improvements in productivity.

While the findings of Solow and others point to productivity improvements as the primary contributors to average growth in the economy, we are also interested in business cycles. Again, using the neoclassical growth model, Solow, followed by Cooley and Prescott, found that sources of business-cycle fluctuations seem to be different from sources of average growth. Because capital, such as machines and structures used by firms, is an input that does not change very much over business cycles, most fluctuations in GDP over business cycles stem from fluctuations in labor inputs. According to Cooley and Prescott, around two-thirds of fluctuations in output per worker stem from fluctuations in labor input; the remainder comes primarily from fluctuations in productivity.

A key lesson from the findings of Solow and those of Cooley and Prescott is that a model capable of accounting for both average growth in GDP and for fluctuations in key macroeconomic variables has two requirements. First, because changes in productivity are important contributors to business cycles, the model needs a way for productivity to change over business cycles. Second, because a majority of fluctuations in GDP stem from changes in labor inputs, the model must include incentives for both households and firms to make large changes in the time devoted to market work over the course of a business cycle.

Finn Kydland and Edward Prescott's influential theoretical and empirical work advanced the idea that fluctuations in macroeconomic conditions are driven largely by random changes in productivity. The work of Kydland and Prescott, as well as subsequent research by other economists, uses a typical macroeconomic model that includes measures of productivity shocks to account for fluctuations in key macroeconomic variables. Using data on labor inputs and capital inputs such as machinery and equipment, along with data on output produced in the economy, Kydland and Prescott, following Solow's earlier work, provide measures that represent the technology of a typical firm in the economy. These measures can be used to gauge how that technology changes over time.

* For a complete description of how researchers use data drawn from the economy to measure technology shocks, see Satyajit Chatterjee's 1995 article.

market work or to leisure. Time devoted to home production is typically not incorporated into the models. But, as we have seen, time and other resources devoted to home production are quantitatively significant.

To see why accounting for time devoted to home production can help a macroeconomic model account for business cycles, we first need a description of what constitutes a typical model, including the choices available to households and business firms in the model.[9] The typical macroeconomic model allows households and firms to make choices *within* a period, such as a quarter, as well as across periods. Market prices determine how goods are allocated *across* possible alternative uses — consumption by households, capital accumulation by firms to facilitate the production of still more goods, and, perhaps, the government's use of goods.

Allowing for choices *within* a period enables households and firms to allocate time available in that period to either work or leisure or other activities and to allocate available resources across possible alternative uses, such as consumption by households or capital accumulation by firms. Choices made within a period about how much time to devote to work in the marketplace and how much to leave for leisure or other activities are important because a majority of short-run fluctuations in GDP stem from variations in labor inputs.

Allowing for choices *across* periods enables the model to include important dynamic responses of households and firms to changes in the economy. For example, if labor productivity randomly increases, households will respond by determining how much capital to accumulate today to be able to produce and consume more in the future.

WHY DO HOUSEHOLDS CHANGE TIME SPENT WORKING IN THE MARKET?

During recessions, fewer hours are devoted to market work, and during expansions, market work usually rises. But what do people who are laid off during recessions, or who have their regular work hours cut back, do with their remaining time? During expansions, what draws more people into market work or into devoting even more time than before to market work? Also, if some people put more time into market work, what happens to the rest of their available time? After all, we have only 24 hours each day.

The lower cost of choosing leisure gives households an incentive to switch from devoting time to market work to devoting more time to leisure.

Sleeping eight hours a day leaves 16 hours for market work, leisure, and home production. So, if during an expansion you decide to work 10 hours at market work, rather than your usual eight, you are left with six hours of nonsleep time. Do you cut back on leisure? Or do you cut back on home production?

The typical business-cycle model has had difficulty answering these basic questions because it postulates a simple choice for households' time allocations: working in the marketplace or enjoying leisure. For example, suppose that, for some reason, the technology used by firms changes so that labor inputs, when combined with other inputs, become less productive, leading to a decline in the demand for labor. This decline in labor demand reduces wages paid to the households that supply labor in the marketplace. Reduced wages produce two effects on households' time-allocation decisions. One is that lower wages make leisure a less costly alternative to market work because households that forgo market work for leisure sacrifice a lower amount of wage income. The lower cost of choosing leisure gives households an incentive to switch from devoting time to market work to devoting more time to leisure. A second effect, though, is that for a given amount of time supplied as market work, lower wages make households less wealthy. This reduction in wealth would lead a typical household to give up some leisure time and spend more time on market work to fend off the loss of wealth.

It is normally assumed that the first effect of declining wages dominates the second. That is, in the face of reduced labor demand and lower wages, households, on balance, choose to switch from time spent at market work to more time spent at leisure. Therefore, a technology shock that lowers labor productivity, reduces labor demand, and lowers wages also leads to a decline in the amount of labor supplied to the market. As a result, employment and output decline, as do wages, and the economy could slip into a recession.[10]

The typical macroeconomic model implies that in times of recession, households facing lower wages *voluntarily* reduce market work in order to engage in more leisure. Many people find this claim dubious.

The typical model also

[9] A technical exposition of the typical macroeconomic model, in which consumption and investment goods are assumed to be identical, can be found in Gary Hansen's article.

doesn't allow for home production. Furthermore, in this model, households cannot accumulate or vary the use of household-capital goods, such as lawnmowers or vacuum cleaners, employed in home production. But, as we saw from estimates of home-production inputs and output, home production involves significant amounts of a household's time and capital goods.

The typical macroeconomic model has been used to describe movements in key macroeconomic variables in the U.S. economy, even though it ignores home production.[11] Let's see how adding home production enriches the model's ability to describe economic activity. Toward that end, we will first describe a standard way of evaluating the typical model's ability to account for key features of the U.S. economy. We will then show how adding households' home-production choices can enhance the typical model's ability to account for the data.

CAN THE TYPICAL MODEL EXPLAIN THE DATA?

The standard way to evaluate a typical macroeconomic model's ability to explain fluctuations in economic variables is to run simulations using the model. Properties of the "artificial," or model-generated, data for key variables are then compared to properties of their counterparts drawn from national income accounts for the U.S. economy. Economists Jess Benhabib, Richard Rogerson, and Randall Wright, among others, have done just that for the typical model without home production. These authors point to a number of the model's shortcomings relative to actual data, shortcomings that including home-production decisions could potentially overcome.[12] Figure 1 shows the variability of GDP and the variability of consumption, investment, and hours worked relative to GDP. As the figure shows, the model finds that compared to U.S. data: (1) GDP itself fluctuates too little in the model; (2) consumption and hours worked fluctuate too little relative to GDP in the model; and (3) investment fluctuates too much relative to GDP in the model.

Why Do the Shortcomings of the Typical Model Arise? The fact that consumption is not variable enough and investment is too variable relative to output in the typical model can be easily understood. In the typical model, when labor productivity is high, for example, relatively fewer labor inputs are devoted to market production of goods for consumption, such as clothing or furniture, and relatively more labor inputs are devoted to production of investment goods, such as machines used by firms to produce output. This switch occurs because people don't want their consumption to fluctuate over time as much as output does. Channeling resources to the production of investment goods facilitates relatively smooth consumption over time because such goods can be accumulated, added to the economy's capital stock, and used to help provide goods for consumption in times when labor productivity is relatively low. Consequently, over time, consumption in the typical model does not vary relative to output as much as we see in actual data, and investment varies more

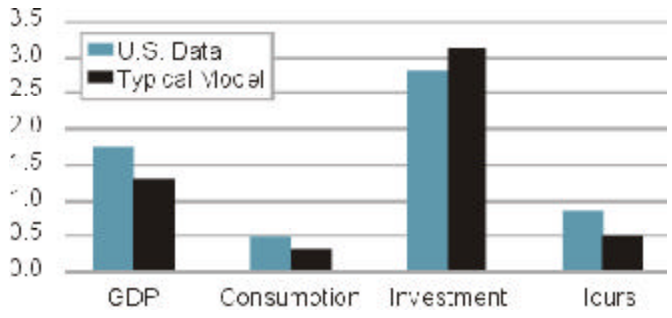
[10] The typical macroeconomic model views business cycles as ups and downs in economic activity relative to the underlying long-run trends in economic activity. The description of employment changes in response to a technology shock is a description of deviations from the long-run trend in employment. Over the long run, hours worked in the marketplace have been fairly constant in the post-war U.S., even though there has been productivity growth and accompanying increases in wages. However, in the short run, at business-cycle frequencies, hours worked in the marketplace tend to vary relative to the trend in hours worked.

[11] The key features of the economy come from data on variables such as GDP, households' consumption of goods and services, firms' purchases of goods as investments to be used in producing more goods in the future, exports and imports, major price indexes, and interest rates.

[12] The typical model refers to a variant of the model in Gary Hansen's article.

FIGURE 1

Variability of Important Economic Indicators



The variability of GDP is measured by its standard deviation, which is a statistical measure of how GDP fluctuates relative to its average value. Relative variability is the standard deviation of either consumption, investment, or hours worked relative to that of GDP. The data are from the article by Greenwood, Rogerson, and Wright.

relative to output than we see in the data.

Similarly, the fact that total hours devoted to market work do not vary much relative to output in the typical model is easy to understand. In the typical model, households switch between hours devoted to producing consumption goods and hours devoted to producing investment goods in response to changes in productivity. When labor productivity is high, for example, fewer hours are spent producing consumption goods, and more hours are spent producing investment goods, but *total hours* devoted to market work don't vary much in the typical model. So, the sum of total hours over a business cycle ends up far less variable relative to output than we observe in the data.

If there were a mechanism in the model to allow more hours to be devoted to producing more consumption goods in the market as well as more investment goods during good times, the typical model would benefit. Not only would hours become more variable than in the typical model, so, too, would total output become more variable. As we'll see, adding a home-production sector to the model provides the needed mechanism.

Does the Addition of Home Production Improve the Typical Model? On many dimensions, adding home production to the typical model improves its ability to account for what we observe in the economy because households now have more choices. Including home production in the model allows households to allocate time among leisure, market work, and home production. The typical model allows a choice only between leisure and market work. Adding home production also means that output must be divided among consumption, investment in business capital, and investment in household capital.

The enriched set of choices results in a model that allows more switching between using time and goods for market activity or for alternative activities in response to the state of the economy. For example, during recessions households become *relatively* more productive places than the marketplace. Hours of market work and household purchases of market goods both decline because households increase the time devoted to producing goods at home, an avenue of substitution ignored in the typical model.

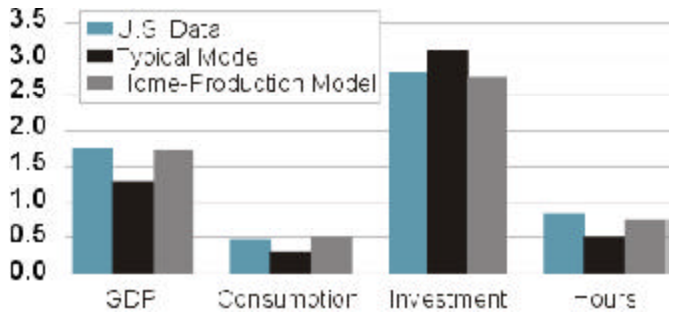
The shortcomings of the typical model can be remedied by including home-production decisions, and we can demonstrate this by comparing U.S. data with data from a typical macroeconomic model and from a model that allows for home-production decisions (Figure 2). To see how home-production decisions improve the typical model, suppose, for example, that there is a period of economic good times with high labor productivity in the marketplace. [14] As in the typical model without home-production decisions, a home-production model will allocate some resources, such as time, to produce additional investment goods that will facilitate production of more consumption goods in future periods.

But now that the model allows for home-production decisions, imagine that in the face of relatively high marketplace productivity, more people have their lawns mowed by landscaping companies — resources shift away from home production (homeowners previously mowed their own lawns) to market production (homeowners now hire landscaping services). Such shifts in resources in a home-production model reflect the fact that people are devoting less of their time to home production (mowing the lawn) while, at the same time, purchasing more consumption goods in the marketplace (landscaping services). Thus, in a model with home production, market production of consumption goods increases, as does

[14] Good times here means periods during which, perhaps because of shocks to technology used in the marketplace or to home-production technology, the marketplace is a relatively more productive place in which to devote resources.

FIGURE 2

Variability of Important Economic Indicators



The variability of GDP is measured by its standard deviation, which is a statistical measure of how GDP fluctuates relative to its average value. Relative variability is the standard deviation of either consumption, investment, or hours worked relative to that of GDP. The data are from the article by Greenwood, Rogerson, and Wright.

production of investment goods. So, not only will production of investment goods vary with increasing labor productivity in the marketplace, as in the typical model, but market production of consumption goods will vary as well and will fluctuate more than in the typical model.[15]

Finally, another shortcoming of the typical model — that output fluctuates too little — can be overcome by a model that includes home production. In the typical model, the size of output variation driven by marketplace productivity shocks reflects only the degree to which people are willing to substitute time and resources across periods in response to a change in marketplace productivity. For example, a household could give up some leisure today when productivity is high and devote that time to market work to allow for more leisure in the future. But when people can switch between market production and home production over time, the variability of market production overall — measured output — increases because of relative differences in productivity in the two types of production. The size of the variations in measured output resulting from relative productivity shocks in a model with home production depends on households' willingness to switch between home production and market production at a given time as well as over time.[16]

SUMMARY

Typical modern macroeconomic models do not account for some important features of U.S. economic data, in part because they ignore a substantial amount of unmeasured economic activity associated with the use of time and resources in the production of goods and services at home. Including home production in modern dynamic models of business cycles seems to be a promising way to help account for movements in key economic variables, especially when we consider the undeniably large amount of time and resources that go into home production.

[15] How well a model with home production explains the data depends critically on the incentives households have and their willingness to substitute between home and market production. The model's implications also depend on the form assumed for the home technology with which households combine time and capital, perhaps subject to random shocks to the technology. Unfortunately, to date there is not much evidence on how shocks to home-production technologies compare with shocks to technologies used by firms in the marketplace. The relative variability of market and home production depends, of course, on the variability of shocks to market productivity relative to home productivity.

[16] Jeremy Greenwood, Richard Rogerson, and Randall Wright present a formal model with home production in their 1993 article. This article also offers a comparison of quantitative implications of the model with properties of U.S. data on key macroeconomic variables.

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