Home Productivity

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Abstract

This paper examines the productivity of home production. I calculate annual home production output and productivity for the United States from 1929 to 2010. Both labor and total factor productivity increased rapidly after World War Two, but slowed after the late 1970s. The household sector is capital intensive due to the importance of residential capital. The capital intensity increased in the late 1970s due to increased consumer durables holdings.

JEL classification: O3.

Keywords: Home production; Labor productivity; Total factor productivity.

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1 Introduction

A large theoretical literature has found that the addition of a home production sector improves the predictions of macroeconomic models[1]. It continues to be an area of active research. For example, a recent literature has examined the effect of productivity growth on changes in the industrial structure of the economy. (See Herrendorf, Rogerson & Valentinyi (2012) for a survey.) Kongsamut, Rebelo & Xie (2001) and Buera & Kaboski (2012*b*) feature neutral technical change and non-homothetic preferences while Ngai & Pissarides (2007) feature differences in technical change across sectors. Other theories, such as Acemoglu & Guerrieri (2008), rely on differing factor shares in production. Determining what forces are at work requires data on factor shares and technical change in home production.

However, little is known about the household sector's basic inner workings since practical considerations caused economic statisticians to exclude it from the National Income and Product Accounts (NIPAs)[2]. Models must be parameterized without the discipline of data. Rather, the models are used to back out what is going on in this sector (Ingram, Kocherlakota & Savin 1997). In a recent example, Rogerson (2008) argues that the household sector is essential to understanding different labor market outcomes in the United States compared to Europe. Since "measures of home sector productivity do not exist," he must use an imprecisely estimated elasticity parameter to back out this productivity.

This paper generates a number of facts about the household sector to guide macroeconomic modeling, with an emphasis on productivity measurement. Improvements in the measurement of time use, such as the regular collection of time use data through the American

[1]Important contributions include Benhabib, Rogerson & Wright (1991) and Greenwood & Hercowitz (1991) on business cycles, Parente, Rogerson & Wright (2000) on the welfare costs of growth distortions and Rupert, Rogerson & Wright (2000) on labor supply elasticities. Greenwood, Rogerson & Wright (1995) surveys its inclusion in macroeconomic models. Recent work includes Aruoba, Davis & Wright (2012) and Aguiar, Hurst & Karabarbounis (2011).

[2]It was a concern during the original work on national income measurement (Kuznets 1934). See Gronau (1986) and Gronau (1997) for surveys of more recent work.

Time Use Study (ATUS), have led to better estimates of the output of this sector. Building on work done by researchers at the Bureau of Economic Analysis (BEA) (Landefeld & McCulla 2000, Landefeld, Fraumeni & Vojtech 2009, Bridgman, Dugan, Lal, Osborne & Villones 2012), I estimate annual home production for the United States from 1929 to 2010 using national income accounting principles. I then examine labor and total factor productivity (TFP) in this sector.

I find that home production has generally declined in importance compared to measured GDP. However during the dislocations of the Great Depression and World War Two, its importance fluctuated significantly. The ratio of home production to measured GDP increased to 85 percent in the depths of the depression (1932) and dropped to 43 percent during the height of the war (1943). The estimates help fill in the historical record on the size of home production by providing the better part of a century of consistent data. Other such estimates include Eisner (1989) and Folbre & Wagman (1993).

Home productivity grew at a rate similar to that of the market economy in the postwar period until the 1970s. Home labor productivity grew an average of 2.0 percent a year during the period 1948-1977, very similar to the 2.1 percent in market. There is a severe slowdown in home productivity in the late 1970s. Labor productivity was nearly flat, growing an average of only 0.02 percent from 1978 to 2010. In contrast, market labor productivity grew 1.6 percent annually.

There has been significant shifts in how the home sector produces output. While the household sector has always been capital intensive due to the importance of residential capital, labor has been progressively replaced by capital since 1978. Capital share drops from 0.5 to 0.37. Most of this increase is due to consumer durables becoming much more important. This large change in capital share suggests that the household sector's production function must allow for substitutability between capital and labor, such as the CES form proposed by Greenwood & Hercowitz (1991).

TFP grows 1.3 percent annually from 1929 to 2010. This growth has not been uniform.

It follows a pattern similar to labor productivity, with strong post-war growth up to 1978. Since then TFP has declined slightly, falling 0.5 percent annually off its 1978 peak.

The evidence is broadly consistent with the "Engines of Liberation" hypothesis, annunciated in Greenwood, Seshadri & Yorukoglu (2005), Greenwood & Guner (2009) and Bar & Leukhina (2011), which argues that the adoption of household appliances induced women to leave the home for paid work. Home productivity shows its largest increase in the three decades after World War Two, the same period that women left the home in large numbers.

A related issue is the welfare cost of discrimination that restricts women to home work or involuntary unemployment from market work, which forces people of both genders into the home. Jones, Manuelli & McGrattan (2003) argue that discrimination kept married women in home production. Such discrimination, such as "marriage bars" where married women were forbidden from market work, is well documented in Goldin (1990). Hsieh, Hurst, Jones & Klenow (2012) argue the efficiency losses of such discrimination are large. The data suggest that the cost of discrimination and unemployment has increased, as the market has become progressively more productive than the household.

2 Home Production Estimates

2.1 Methodology

The basis for the estimates are a series of papers from BEA that calculate U.S. household production using national accounting conventions (Landefeld & McCulla 2000, Landefeld et al. 2009, Bridgman et al. 2012). While the details of the calculation can be found in those articles, this section summarizes the calculation.

The basic strategy is to estimate value added by imputing income to the factors of production: labor L and capital K. Labor input is uncompensated hours in household production drawn from time use surveys[3]. The imputed wage w is hourly compensation of workers

[3]Time use surveys were not conducted annually until 2003, so most years are interpolations. The general

employed in the household sector, under the assumption that market and non-market workers have the same marginal product of labor in the home. There are three types of capital used by the household: consumer durables, residential capital and governmental capital provided to the household and used in production[4]. The capital services are the asset rate of return r^j for each type of capital plus depreciation δ^j, for $j \in \{Durables, Residential, Government\}$. The rate of returns used are households' financial asset returns for durables, imputed rents for residential and government debt returns for government capital. Formally, household output Y is given by:

$$Y = C + I = wL + \sum_j [(r^j + \delta^j)K^j + I^j] \tag{2.1}$$

Note that several components, such as the services of residential capital and investment in household capital, are already included in measured GDP. Therefore, home production is not purely an addition to measured GDP. Home productivity will include all household output, not just the new imputations.

The BEA estimates cover the period 1946 to 2010. This paper extends them back to 1929 using as similar methodology as possible. (Details on the data are reported in the Appendix.) There are two main differences in the calculation for the 1929 to 1945 period. First, I use the home production hours estimates from Ramey (2009) and Ramey & Francis (2009) as the measure of labor hours[5]. Second, the capital return series used to impute capital services of consumer durables in the BEA estimates does not exist for the earlier period. Instead I use the Moody's Seasoned Baa Corporate Bond Yield. Both series overlap with the BEA data.

methodology is to disaggregate hours data in survey years by demographic group then project non-survey years using data on population size of those groups.

[4]Governmental capital is half of the "Highways and streets" category of government capital. Half is chosen based on a 2000 survey road use that found that half of car passenger milage was accounted for by non-commuting household travel. Using the 2000 share for the whole period is arbitrary, but has very little quantitative impact since government capital services are tiny.

[5]I generate total hours by multiplying their estimate of average weekly hours by the population and 52 (the number of weeks in a year).

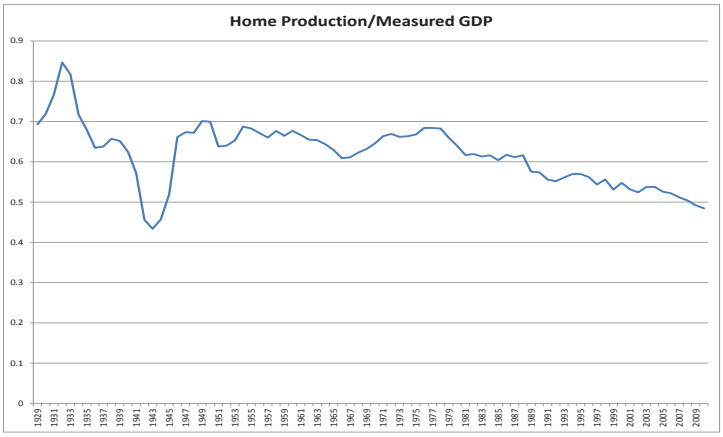
They give very similar estimates. I discuss the robustness of the estimates below.

2.2 Home Production 1929-2010

Home production has declined in importance in the economy. As Figure 1 shows, home production fell from nearly 70 percent of measured GDP to less than 50 percent. This decline in importance has been noted in the BEA work for recent years. The extended series shows that trend extends back to before the Great Depression.

Recall that household production includes items that already included measured GDP, such as housing services and investment. Therefore, this ratio is not a measure of how much GDP would increase if household production was included. Rather, it measures the size of this production compared to measured GDP. The amount GDP would increase due to new imputations follows the size of home production relative to measured GDP closely. It peaks in 1932 at 59 percent and drops to 31 percent in 1942.

Figure 1: U.S. Home Production/GDP, 1929-2010



While the overall trend has been negative, there are significant swings during the Great

Depression and World War Two. Home production did not fall as much as the rest of the economy during the Depression making it almost are big as measured GDP. Market hours far significantly while household production hours increase slightly (Ramey 2009).

The opposite happens during the war, where home production drops to its lowest percentage of GDP in the series. This shift largely reflects the recovery in the market sector. It also reflects restriction on the production of home capital as production was geared to war materiel. The movement of women into the defense industries and out of the home, the "Rosie the Riveter" (real name: Bernice Olsen) effect, is minor. Women's average hours in home production does not fall much[6].

3 Labor Productivity

To measure productivity, we need to deflate the nominal household output to put it in real terms. As a baseline, I use the price index for private household output. This sector is comprised of the services of owner-occupied housing and the compensation paid to domestic workers. This measure is the closest to the concept of household production in the published NIPAs. I discuss the robustness of this choice below.

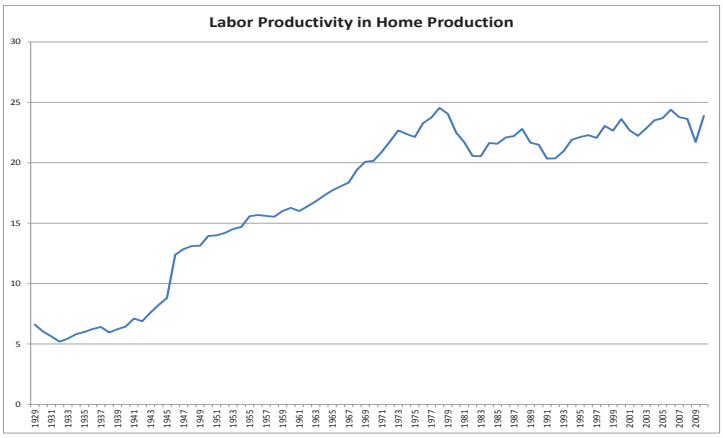
Figure 2 shows labor productivity in home production, as measured by real value added per hour. Productivity increased rapidly after World War Two until the late 1970s, growing an average of 2.0 percent a year from 1948-1977. This rate is similar to that of the market economy, which 2.1 percent per over the same period[7]. It is flat both during the depression and war and after 1978. Home productivity only grew an average of only 0.02 percent from 1978 to 2010 while market labor productivity grew 1.6 percent per year.

The home sector is less productive than the rest of the economy, a gap that has been

[6] As documented in Goldin & Olivetti (2013), World War Two had an impact on women's labor participation after the war.

[7] Labor productivity is measured as GDP per hour using BEA's measure of total market hours: NIPA Table 6.9, line 1.

Figure 2: Labor Productivity in Home Production 1929-2010

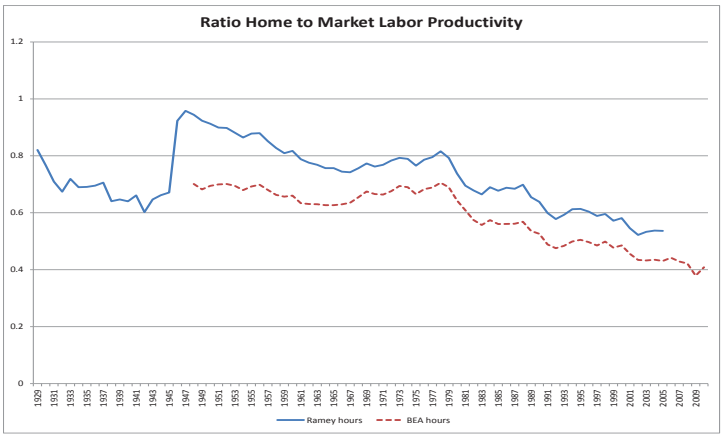


increasing. Figure 3 shows the ratio of home productivity to real GDP per market hour worked. In addition to the BEA hours used above, I use market labor hours are calculated as average work week from Ramey (2009) times the population times 52, the number of weeks. This measure is broadly consistent with the BEA measure, but has a higher level. Therefore, labor productivity is lower with the Ramey (2009) hours. Since neither series has full coverage of the sample period (Ramey (2009) ends in 2005 and the BEA data begin in 1948) so I report both.

After the low ebb of the Depression and the war, an hour of home production produced nearly as many dollars of value added compared to the economy measured by GDP (using the Ramey (2009) hours). No matter which hours are used, the home sector has become relatively less productive since then. In 2005, an hour of work produced $23.69 of value added compared to $44.19 for market work (using the Ramey (2009) hours). This finding supports the assumption in Nosal, Rogerson & Wright (1992) that workers would prefer to work in the market.

The data suggest that the economic cost of distortions, such as discrimination (Goldin

Figure 3: Ratio of Home to Measured GDP Labor Productivity 1929-2010



1990) or taxes (Rogerson 2008), that increase home production share, has increased over time. This increase may help explain the decline in discriminatory barriers to married women entering the labor force.

This fact also suggests that home production provides less of a cushion for recessions. Workers that leave the market sector for the home sector have increasing output losses. This finding is consistent with Aguiar et al. (2011) and Bridgman et al. (2012), who find adding a home sector does little to reduce volatility of output. In fact, home productivity is pro-cyclical which accentuates the lack of insurance home production provides. The correlation between market and home labor productivity is 0.30. However, the gap between in the level of productivity is probably more important, as emphasized by McGrattan, Rogerson & Wright (1993).

The slower growth in the household sector is consistent with some estimates of home productivity backed out of models. Rogerson (2008) estimates that productivity growth in the household sector from 1956 to 2003 was slower than market sectors. Over this period, home

productivity grew 0.8 percent a year compared to 1.8 for the market sector (using BEA hours).

4 Total Factor Productivity

This section examines total factor productivity (TFP) in the household sector. This calculation requires taking a stand on how capital and labor are combined. I begin by examining what production functions are consistent with data. I show the evidence is consistent with a production function that allows for substitutability between capital and labor, such as the CES function. I then calculate TFP using a labor augmenting CES function.

4.1 Production Function

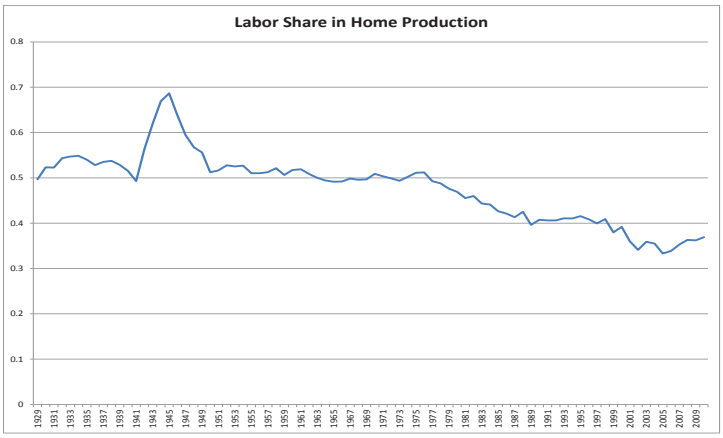
Since there is little data on home production, we have little direct evidence on what the appropriate home production function is. As a result, there is no consensus in the literature on what form to use. The most common production function in macroeconomics is Cobb-Douglas. It was used by Benhabib et al. (1991) among others.

As shown in Figure 4, home production shows a significant change in labor share which indicates that the Cobb-Douglas production function is a poor fit for the data. In the early period, households invest very little in home capital. As discussed above, World War Two severely restricted home investment. In the later period, the opposite is true. Households replace labor input with capital input. As a result, the labor share of the sector declines.

Home production is capital intensive, and has become more so over time. Labor share falls from 0.50 in 1929 to 0.37 in 2010. This high capital intensity is due to the large stock of residential capital. Consumer durables have become more important, increasing from 5.5 to 21.6 percent of real home capital held by the household from 1929 to 2010.

Given the change in factor shares, a more promising form is a CES production function that allows for more flexible substitution between inputs. (It collapses to Cobb-Douglas when the capital-labor elasticity is equal to one). A difficulty with this form is that the productivity

Figure 4: Labor Share in Home Production 1929-2010



process is also more flexible. Each input can have a separate productivity process, whereas in Cobb-Douglas productivity is always Hicks-neutral. Identifying the degree of bias in technical change has been a long standing controversy, since the capital-labor elasticity and technical biases are not separately identified. Some structural assumption is required to proceed. (See Leon-Ledesma, McAdam & Willman (2010) for a survey of this literature.)

As a baseline, I use labor augmenting technical change:

$$Y_t = [\theta K_t^{\lambda} + (1-\theta)(A_t L_t)^{\lambda}]^{\frac{1}{\lambda}} \tag{4.1}$$

where Y_t is home production, K_t is household capital and L_t is hours of home production.

I selected this functional form since it has been used previously in the literature. For example, it was used by Greenwood & Hercowitz (1991) and Gomme, Kydland & Rupert (2001). The TFP calculation is not significantly changed by alternative assumptions on how productivity enters.

4.2 TFP Results

Once we have selected a functional form, we have two additional tasks before we can calculate TFP. We need a measure of real capital inputs and we need parameter values for the production function.

As the measure of capital, I aggregate the three capital inputs (consumer durables, residential and governmental capital) into a capital index. Since BEA's real capital stocks are calculated using chain weighted price indices, we cannot simply add the deflated capital series. Following BEA's methodology, I generated a psuedo-Fisher index of capital input[8].

Finally, for baseline parameter values I use the estimates from McGrattan, Rogerson & Wright (1997). They find that $\lambda = 0.19$ and $\theta = 0.22$.

Line "CES TFP (Labor augmenting)" in Figure 5 shows the baseline estimate of TFP. Over the sample period, TFP grows an average of 1.3 percent a year. There are significant differences over time. There is little growth during the Depression. TFP grows steadily during the postwar period prior to 1978 then flattens out. From 1945 to 1978, TFP grew 2.7 percent, compared to -0.5 percent annually from afterward. The slowdown in TFP coincides with the slowdown in labor productivity.

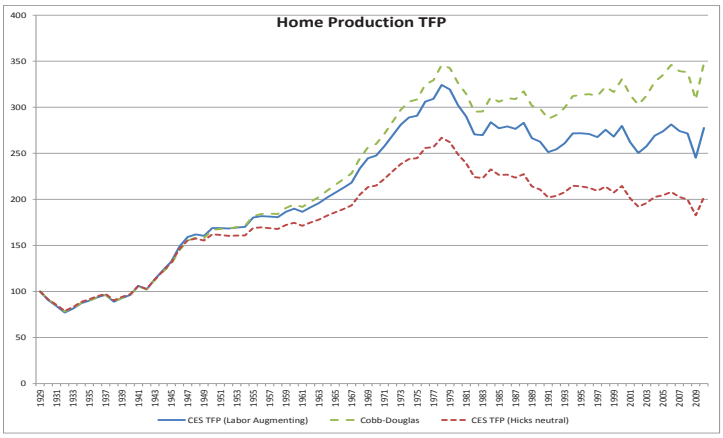
To see how sensitive the results are to the assumption on technical bias, I calculate TFP using a Hicks neutral CES production function using the same values for θ and λ:

$$Y_t = A_t[\theta K_t^{\lambda} + (1-\theta)(L_t)^{\lambda}]^{\frac{1}{\lambda}} \tag{4.2}$$

Line "CES TFP (Hicks neutral)" in Figure 5 shows this estimate. The pattern of growth is very similar, though the magnitude of TFP growth is smaller. The average growth rate over the sample is 0.9 percent, compared to 1.3 percent in the baseline case. This slower growth is seen in every subperiod. The postwar growth period (1945 to 1978) is a bit slower (2.2 percent compared to 2.7 percent in the baseline) and the slowdown a bit worse (-0.8 percent annually versus -0.5 percent a year).

[8]This methodology can be found at http://www.bea.gov/national/FA2004/Details/xls/DetailCDG.xls.

Figure 5: Total Factor Productivity in Home Production 1929-2010

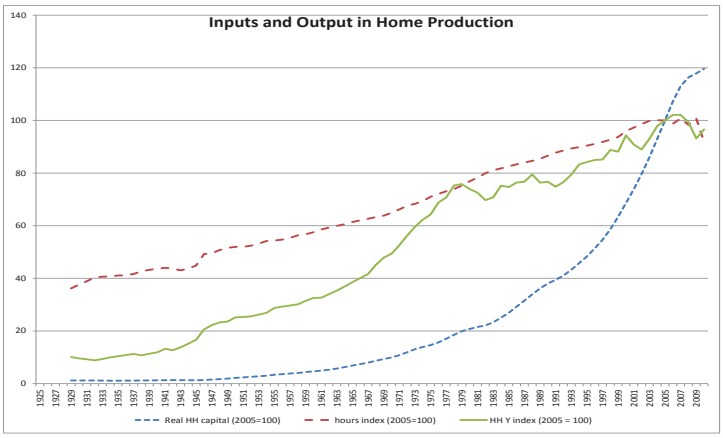


Changing the capital-labor elasticity has a similar effect. I set $\lambda = 1$ to collapse the CES into a Cobb-Douglas function. Again, as seen in line "Cobb-Douglas" in Figure 5, the pattern is unchanged though the magnitudes are larger.

As shown in Figure 6, the productivity slowdown coincides with a slowdown in home output. Capital input is exploding while output grows slowly. Since inputs are growing while output slows, TFP will slow for most functional forms and parameters. It is only the magnitudes that will be sensitive to such changes.

While the data are annual, productivity is pro-cyclical. The baseline TFP measure and real GDP has a correlation of 0.45 over the period 1929 to 2010. This observation matches with Greenwood & Hercowitz (1991) and (Fisher 2007), who use models where home and market productivity shocks are correlated to generate the empirical co-movement of home and market investment. The data confirm this positive correlation.

Figure 6: Inputs and Output in Home Production 1929-2010



4.3 Why did productivity slow down?

Why did productivity slow in the late 1970s? The year 1978 marks a significant change in the household sector. It is the year that labor share begins a concerted decline.

It is surprising that the shifts occur so late. The mechanism emphasized by the "Engines of Liberation" hypothesis, the diffusion of household appliances that the allowed women to leave the home for paid work, was well underway by the 1970s. (See Greenwood et al. (2005), Greenwood & Guner (2009) and Bar & Leukhina (2011).) According to the Census, half of women worked in the market in 1980 nearly double the rate in 1950 (27.1 percent)[9]. The binary choice some or no market hours masks a slower increase in average hours worked by women, especially married white women (Jones et al. 2003).

Strong productivity growth may have initially held married women in the household sector. Households may have responded to increasing productivity by increasing home production. The introduction of household appliances did not reduce married women's hours and may

[9]Historical Statistics of the United States, Millennial Edition, series ba345

have even increased household work (Mokyr 2000), an effect Cowan (1983) called "more work for mother." Since vacuum cleaners made it easy to keep the rugs clean, married women may have cleaned the rugs more often. The household enjoyed a cleaner house rather than send the wife into market work. When household technology fell behind the market, there was less reason to stay home. The rugs were not much cleaner while market wages were increasing.

The late 1970s may mark the point at which household capital no longer embodied significant new technologies. The innovations that changed the nature of household work, for example electric washers and vacuum cleaners, were in nearly every home by the 1980s. Falling capital prices led to an increase in capital along the intensive margin but did not lead to a reorganization of household production in the way that the innovations of the early 20th century did. Since home production is not information intensive, improvements in computer technology that revolutionized some market sectors had less impact on the home.

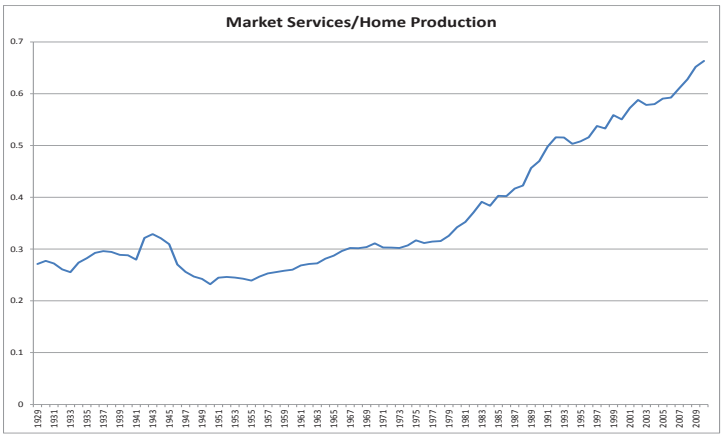
The slowdown coincides with an increasing shift to market services purchases. Figure 7 shows that services purchased by households accelerates compared to home production[10]. The late 1970s may mark a shift to "marketization," purchasing more services outside the household rather than making them at home (Freeman & Schettkat 2005)[11].

This marketization of services may have led to a change in the composition of household workers. It coincides with an increasing gap between women's market wages and the wages of household employees (Bridgman et al. 2012). Buera & Kaboski (2012*a*) argue that increasing returns to skill drew skilled workers in the home sector into market work, a process that has empirical support in Mulligan & Rubenstein (2008). The estimates do not account for the returns to human capital. The flow of skilled women from household work into market work

[10]Purchased services are current dollar personal consumption expenditure (PCE) on services less housing services (including utilities).

[11]This ratio mixes a value added measure (household production) with a final expenditure measure (Herrendorf, Rogerson & Valentinyi forthcoming). I generate gross home product by adding non-durable PCE and utilities to the value added home production, under the assumption that non-durable PCE is an intermediate input to home production. Movements in the ratio are similar with this measure.

Figure 7: Market (PCE) Services/Home Production 1929-2010



would leave lower skilled, less productive workers behind. If the paid portion of household work (from which the imputed wages are calculated) also reflected this change in skill composition, the imputed wages will reflect a decline in average productivity.

5 Robustness

This section examines the robustness of the results to alternative data sources and assumptions.

5.1 Early Data Sources

Some of the data sources used for the post war estimates do not extend back to 1929. Therefore, replacement series were used. The two deviations were the use of hours estimates from Ramey (2009) and the use of Moody's corporate bond returns to value consumer durable output.

The replacement series overlap with the baseline data sources, so we can directly compare them. The use of these series has no quantitative impact on the results.

The Ramey (2009) hours data is nearly identical to the hours used in the post war era, so home production is essentially unchanged using them. The underlying time use sources are the same, so the interpolated hours are very similar.

The estimates of household capital are also not significantly changed using the bond yields. During the period immediately after the war (1946-1957), the estimates are nearly indistinguishable. Even if the yields were different in the 1930s and 1940s, consumer durables make up a small portion of household capital. Therefore, the impact on overall output is limited.

5.2 Price Deflators

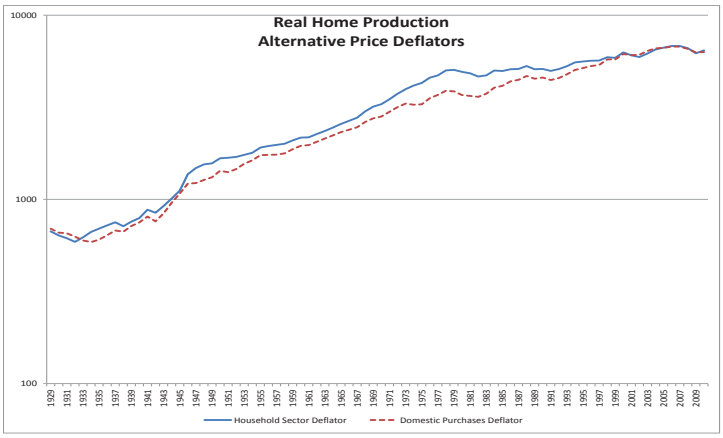
The baseline estimate uses household sector deflator to deflate nominal home production. While the year to year movements in output are sensitive to this choice, the overall growth of the sector is not. Figure 8 shows real home production using the original deflator and the gross domestic purchases deflator. Overall growth from 1929 to 2010 is unaffected. However, the timing of the growth is. The baseline shows fast growth after World War Two and a slowdown in the late 1970s. The GDP deflator shows more steady growth.

The choice of deflator affects the year to year movements, but does not significantly change the overall picture. Labor productivity grows an average of 1.6 percent a year in both cases. The baseline shows more rapid growth up to 1978 (3.1 percent a year compared to 2.4 percent with the domestic purchases deflator) but both slow after 1978 (-0.1 percent and 0.8 percent per year respectively). In both cases, the postwar era shows strong productivity growth until the late 1970s after which there is a slowdown.

6 Conclusion

This paper calculates labor and total factor productivity for home production in the United States from 1929 to 2010. Many of the facts about household sector that this paper generates

Figure 8: Real Home Production under Alternative Deflators 1929-2010



are consistent with theoretical work. For example, there has been a shift from labor to capital in the form of consumer durables as suggested by the "Engines of Liberation" literature. It also generates a number of novel facts. Home production shows a productivity slowdown in the 1970s and exhibits pro-cyclical productivity. It also shows a surprisingly high capital intensity. These observations can help guide model and parameter choice for a large number of areas in macroeconomics.

A Data: 1929 to 1945

Hours in Home Production Average weekly hours in home production, 14+ population from Ramey (2009) multiplied by 14+ population (Historical Statistics of United States, Millennial Edition, series aa140) multiplied by 52 (weeks per year).

Consumer Durables rate of return Moody's Seasoned Baa Corporate Bond Yield, accessed from FRED database, FRB-St. Louis, November 5th, 2012.

Government rate of return Long term U.S. government bond yields, Historical Statistics of United States, Millennial Edition, series cj1192.

Price deflator Price indices by Gross value added by sector, BEA NIPA table 1.3.4, line 10 (households). Accessed from BEA.gov, November 5th, 2012.

References

Acemoglu, Daron & Veronica Guerrieri (2008), 'Capital deepening and nonbalanced economic growth', *Journal of Political Economy* **116**(3), 467–498.

Aguiar, Mark, Erik Hurst & Loukas Karabarbounis (2011), Time use during recessions, Working Paper 17259, NBER.

Aruoba, S. Boragan, Morris A. Davis & Randall Wright (2012), Homework in monetary economics: Inflation, home production, and the production of homes, Working paper, University of Wisconsin.

Bar, Michael S. & Oksana Leukhina (2011), 'On the time allocation of married couples since 1960', *Journal of Macroeconomics* **33**(4), 491–510.

Benhabib, Jess, Richard Rogerson & Randall Wright (1991), 'Homework in macroeconomics: Household production and aggregate fluctuations', *Journal of Political Economy* **99**(6), 1166–1187.

Bridgman, Benjamin, Andrew Dugan, Mikhael Lal, Matthew Osborne & Shaunda Villones (2012), 'Accounting for household production in the national accounts, 1965–2010', *Survey of Current Business* **92**(5), 23–36.

Buera, Francisco & Joseph Kaboski (2012*a*), 'The rise of the service economy', *American Economic Review* **102**(5), 2540–2569.

Buera, Francisco & Joseph Kaboski (2012*b*), 'Scale and origins of structural change', *Journal of Economic Theory* **147**, 684–712.

Cowan, Ruth Schwartz (1983), *More Work for Mother*, Basic Books, New York.

Eisner, Robert (1989), *The Total Incomes System of Accounts*, University of Chicago Press, Chicago.

Fisher, Jonas D. M. (2007), 'Why does household investment lead business investment over the business cycle?', *Journal of Political Economy* **115**(1), 141–168.

Folbre, Nancy & Barnet Wagman (1993), 'Counting housework: New estimates of real product in the United States, 1800-1860', *Journal of Economic History* **53**(2), 275–288.

Freeman, Richard B. & Ronald Schettkat (2005), 'Marketization of household production and the EU-US gap in work', *Economic Policy* **20**(41), 7–50.

Goldin, Claudia (1990), *Understanding the Gender Gap: An Economic History of American Women*, Oxford University Press, New York.

Goldin, Claudia & Claudia Olivetti (2013), Shocking labor supply: A reassessment of the role of World War II on U.S. women's labor supply, Working Paper 18676, NBER.

Gomme, Paul, Finn E. Kydland & Peter Rupert (2001), 'Home production meets time to build', *Journal of Political Economy* .

Greenwood, Jeremy, Ananth Seshadri & Mehmet Yorukoglu (2005), 'Engines of liberation', *Review of Economic Studies* **72**(1), 109–133.

Greenwood, Jeremy & Nezih Guner (2009), Marriage and divorce since World War II: Analyzing the role of technological progress on the formation of households, *in* D.Acemoglu, K.Rogoff & M.Woodford, eds, 'NBER Macroeconomics Annual 2008', University of Chicago Press, Chicago, pp. 231–276.

Greenwood, Jeremy, Richard Rogerson & Randall Wright (1995), Household production in real business cycle theory, *in* T. F.Cooley, ed., 'Frontiers of Business Cycle Research', University of Princeton Press, Princeton, pp. 157–174.

Greenwood, Jeremy & Zvi Hercowitz (1991), 'The allocation of capital and time over the business cycle', *Journal of Political Economy* **99**, 1188–1214.

Gronau, Reuben (1986), Home production: A survey, *in* O.Ashenfelter & R.Layard, eds, 'Handbook of Labor Economics Vol. 1', North-Holland, Amsterdam.

Gronau, Reuben (1997), 'The theory of home production: The past ten years', *Journal of Labor Economics* **15**(2), 197–205.

Herrendorf, Berthold, Richard Rogerson & Akos Valentinyi (2012), Growth and structural transformation, *in* 'Handbook of Economic Growth Vol. 2', North Holland, Amsterdam.

Herrendorf, Berthold, Richard Rogerson & Akos Valentinyi (forthcoming), 'Two perspectives on preferences and structural transformation', *American Economic Review* .

Hsieh, Chang-Tai, Erik Hurst, Charles I. Jones & Peter J. Klenow (2012), The allocation of talent and U.S. economic growth, mimeo, University of Chicago-Booth.

Ingram, Beth F., Narayana R. Kocherlakota & N.E. Savin (1997), 'Using theory for measurement: An analysis of the cyclical behavior of home production', *Journal of Monetary Economics* **40**, 435–456.

Jones, Larry E., Rudolfo E. Manuelli & Ellen McGrattan (2003), Why are married women working so much?, Staff Report 317, Federal Reserve Bank of Minneapolis.

Kongsamut, Piyabha, Sergio Rebelo & Danyang Xie (2001), 'Beyond balanced growth', *Review of Economic Studies* **68**, 869–882.

Kuznets, Simon (1934), *National Income 1929-1932, Senate Document No. 124, 73rd Congress, 2nd Session*, U.S. Government Printing Office, Washington.

Landefeld, J. Steven, Barbara Fraumeni & Cindy M. Vojtech (2009), 'Accounting for household production: A prototype satellite account using the American Time Use Survey', *Review of Income and Wealth* **55**(2), 205–225.

Landefeld, J. Steven & Stephanie H. McCulla (2000), 'Accounting for nonmarket household production within a national accounts framework', *Review of Income and Wealth* **46**(3), 289–307.

Leon-Ledesma, Miguel A., Peter McAdam & Alpo Willman (2010), 'Identifying the elasticity of substitution with biased technical change', *American Economic Review* **100**, 1330–1357.

McGrattan, Ellen, Richard Rogerson & Randall Wright (1993), Household production and taxation in the stochastic growth model, Staff Report 166, Federal Reserve Bank of Minneapolis.

McGrattan, Ellen, Richard Rogerson & Randall Wright (1997), 'An equilibrium model of the business cycle with household production and fiscal policy', *International Economic Review* **38**(2), 267–290.

Mokyr, Joel (2000), 'Why was there more work for mother? technological change and the household, 1880-1930.', *Journal of Economic History* **60**(1), 1–40.

Mulligan, Casey & Yona Rubenstein (2008), 'Selection, investment, and women's relative wages over time.', *Quarterly Journal of Economics* **123**(3), 1061–1110.

Ngai, L. Rachel & Chrisopher A. Pissarides (2007), 'Structural change in a multisector model of growth', *International Economic Review* **97**, 429–443.

Nosal, Ed, Richard Rogerson & Randall Wright (1992), 'The role of household production in models of involuntary unemployment and underemployment', *Canadian Journal of Economics* **25**(3), 507–520.

Parente, Stephen L., Richard Rogerson & Randall Wright (2000), 'Homework in development economics: Household production and the wealth of nations', *Journal of Political Economy* **108**(4), 680–687.

Ramey, Valerie (2009), 'Time spent in home production in the 20th century United States', *Journal of Economic History* **69**, 1–47.

Ramey, Valerie & Neville Francis (2009), 'A century of work and leisure', *American Economic Journal: Macroeconomics* **1**, 189–224.

Rogerson, Richard (2008), 'Structural transformation and the deterioration of european labor market outcomes', *Journal of Political Economy* **116**(2), 235–259.

Rupert, Peter, Richard Rogerson & Randall Wright (2000), 'Homework in labor economics: Household production and intertemporal substitution', *Journal of Monetary Economics* **46**, 557–579.