# Explaining Hours Worked Across and Within Countries: Income Effects vs. Taxes and Transfers

Alexander Bick, Arizona State University

Nicola Fuchs-Schündeln, Goethe University Frankfurt and CEPR

David Lagakos, UCSD and NBER

Hitoshi Tsujiyama, Goethe University Frankfurt

February 15, 2019

Preliminary and incomplete; comments welcome

**Abstract**

Why are aggregate hours worked per adult lower in rich countries than in poor countries? Why is the individual hours-wage gradient positively sloped within rich countries and negatively sloped within poor countries? To answer these questions we build a model in which hours worked at the individual and aggregate level are shaped primarily by two distinct forces. The first force is preferences in which income effects dominate substitution effects in labor supply. The second force is the larger tax-and-transfer systems of richer countries, which lowers labor supply of all workers, particularly those with the lowest earning ability. In spite of its simplicity, the model performs well in quantitatively explaining the cross-country patterns of hours worked at the individual and aggregate level. Counterfactual exercises using the model predict that income effects are the most relevant factor for understanding how aggregate hours worked vary with GDP per capita across countries. Both income effects and tax-and-transfer systems are necessary to explain why individual hours-wage gradients turn from negative to positive with a country's development level. These conclusions hold in an extended model that includes capital accumulation, self-employment, transitory income shocks and extensive and intensive labor supply decisions. We conclude that ignoring either one of the two forces in models of aggregate labor supply could lead to misleading inferences about th determinants of aggregate hours worked.

Email: alexander.bick@asu.edu, fuchs@wiwi.uni-frankfurt.de, lagakos@ucsd.edu, and hitoshi.tsujiyama@hof.uni-frankfurt.de. For helpful comments we thank seminar audiences at Bonn University, Monash University, the Reserve Bank of Australia, the University of Melbourne, the University of Queensland, and the University of Vienna. Fuchs-Schündeln gratefully acknowledges financial support from the European Research Council under the ERC Consolidator Grant No. 815378. All potential errors are our own.

# 1. Introduction

Both time-series evidence and cross-country data on hours worked point to a pattern of lower aggregate hours worked in economies with higher income per capita. At the turn of the 20th century, U.S. adults worked an average of 28 hours per week, whereas nowadays, hours per adult have fallen to 24 hours per week (Ramey and Francis, 2009). Hours in Western European countries have also fallen systemically over the last century (Boppart and Krusell, 2018). For example, German adults worked around 28 hours in the 1950s compared to around 17 hours today (Ohanian et al., 2008). The cross-section of countries in the world today shows a remarkable similarity with these time series trends. In the bottom third of the world income distribution, adults work 29 hours per week on average, while in the top third, adults average just 19 hours per week (Bick et al., 2018).

Within countries, the pattern of income and hours worked also varies systematically with aggregate income. In particular, the individual hours-wage gradient – defined as the slope of log hours worked on log wage at the individual level – is *positive* in rich economies, and *negative* in poor countries. According Costa (2000), around the turn of the 20th century, the hours-wage gradient had a slope of around -0.2 among U.S. males, meaning that men with the lower wages worked longer hours on average than those with higher wages. Around the 1960s, the hours-wage gradient began to flatten out, and by 2005, this pattern had reversed, with high-income males working more hours than low-wage males (Aguiar and Hurst, 2007). In the cross-section of countries at present, Bick et al. (2018) find that individual hours-wage gradients are around -0.1 on average in the poorest countries, and around 0.1 in the richest countries. The correspondence between the time series and cross-country evidence suggest that the flattening individual hours-income gradient as GDP rises may be a fundamental part of the development process.

In this paper, we ask what explains these patterns, and whether the same forces can explain both why aggregate hours vary negatively with income, and why individual hours-wage gradients reverse from downward to upward sloped with development. To do so, we build a model of aggregate and individual labor supply by households that differ in permanent productivity levels and face common aggregate forces. Two broad forces shape the pattern of hours worked in our model. The first is income effects in preferences, which reduce desired labor supply as individual wages rise. This view dates back at least to Keynes (1930), who argued that declining hours around the turn of the 20th century were due to higher income levels (see Ohanian, 2008, for a modern interpretation.). Recently, the income-effects view has been embraced recently by Boppart and Krusell (2018), who reconcile the relatively constant rate of hours decline in income with a new specification of preferences in which income effects in labor supply everywhere dominate substitution effects. Similarly, Restuccia and Vandenbroucke (2013) adopt Stone-Geary preferences to capture income effects in labor supply and to explain the declining U.S. hours worked over the last century.

The second broad force in our model is tax-and-transfer systems, which are well known to be larger on average in richer economies (see e.g. Besley and Persson, 2014; Jensen, 2019). For example, Ohanian et al. (2008) argue that the declining pattern of hours in Europe since the 1950s is due almost entirely to rising tax rates. More generally, a large literature argues that Europe-U.S. differences in average hours worked can be traced to differences in taxation of labor income (e.g. Prescott, 2004; Rogerson, 2006, 2008; McDaniel, 2011; Bick and Fuchs-Schündeln, 2017b,a). This literature has concluded that higher marginal tax rates discourage labor supply along the extensive margin and lower the hours of those employed. At the same time, higher transfers (or publicly provided services) also dull incentives to work, particularly for those with the lowest earning ability.

Our benchmark model has the simplest number of features necessary to study the patterns of individual and aggregate hours worked discussed above. The model is static and populated by a unit measure of households that are heterogeneous in labor productivity. Households solve a simple labor-leisure problem which is meant to capture a choice of lifetime labor supply given their level of "permanent income." Households have Stone-Geary preferences which give rise to income effects that dominate substitution effects in labor supply. The government levies a marginal tax on labor earnings and uses the proceeds to pay for public goods, which we assume are rebated lump-sump to households. Economies differ in two ways: first, an aggregate efficiency term, which determines the marginal product of labor, and second, the size of the tax-and-transfer system.

We discipline the model to match average aggregate hours worked in the bottom quartile of the world income distribution, standard measures of subsistence consumption needs, and sizes of tax-and-transfer systems from the cross-section of countries in 2005. We then assess how well the model does in matching aggregate hours per adult, and individual hours-wage gradients within countries, across the full world income distribution. We find that, in spite of its simplicity, the model does well in matching both the aggregate and individual hours patterns. In both the model and data, hours fall by about 50 percent from the poorest to the richest countries, and hours-wage gradients in the model fall from a slope of -0.2 in the poorest countries to 0.1 in the richest countries, compared to -0.1 and 0.1 in the data. Thus, the calibrated model is a useful laboratory to disentangle the relative importance of income effects and tax-and-transfer systems.

We then shut down the income-effects channels and tax-and-transfer channels one at a time to assess their explanatory power in explaining the pattern of average hours worked and income within and across countries. We begin by counterfactually shutting down country differences in tax-and-transfer systems, by giving all countries the (minimal) tax systems of the poorest countries. We find that this change on its own makes a modest differences in explaining the patterns. In this exercise, hours worked would fall by around 40 percent from the poorest countries to the richest countries rather than the 50 percent observed in the data. Hours in the bottom half of the income distribution are hardly affected, mostly since tax-and-transfer systems are quite minimal on average for most countries in this income range.

We next restore the tax-and-transfer systems and remove the subsistence term from preferences, which returns to "balanced growth" preferences, where income effects and substitution in labor supply decisions cancel out. In this exercise, hours are counterfactually similar, with only a modest decline from 21 hours on average in poor countries to 19 in rich countries. Hours-wage gradients are also a bit too similar in rich a poor countries, with a gradient of zero in the poorest countries and 0.1 in the richest. Overall, the lesson in these counterfactual exercises is that income effects explain the lion's share of the cross-country differences in average hours worked by level of GDP per capita. To explain the patterns of hours-wage gradients, both income effects and tax-and-transfer systems are important, with each explaining about half the cross-country patterns we observe.

A natural concern with our simple benchmark model is whether our conclusions are driven by the relatively stylized description of individual labor supply decisions. For example, the model has no notion of an extensive and intensive margin, allows only for permanent income heterogeneity and treats all individuals as making independent decisions, rather than being parts of households. Individuals also based their consumption-leisure decisions only on wage income, but not capital income, and the choice between wage work and self employment is similarly absent. To address this concern, we next consider an extension of the basic model that captures these rich features of reality that may be relevant for understanding cross-country patterns of labor supply. This extended version of the model paints a more nuanced picture of how hours vary across individuals within a country, but largely returns the same conclusion as before. In particularly, income effects still play the dominant role in explaining how hours vary with GDP per capita, and both income effects and tax-and-transfer systems are crucial for matching the individual hours-wage gradients.

The rest of the paper is organized as follows. Section 2 reviews the aggregate and individual-level facts on hours worked to be explained. Section 3 presents the benchmark model and the results of its quantitative analysis. Section 4 introduces the extended version of the model, Section 5 brings it to the data, and Section 6 presents the quantitative predictions of the extended model. Section 7 concludes.

## 2. Hours Worked Across and Within Countries: Summarizing the Facts

In this section we review the cross-country facts on how hours worked vary with income at the individual and aggregate level. To be clear, nothing in this section is novel to the current paper. Still, it is useful to review the facts that will the current paper will attempt to explain in what follows.

In Bick et al. (2018), we assemble labor force surveys from 80 countries across the world income distribution in order to document how hours worked vary with income across and within countries. The main facts are derived from the surveys of 49 "core countries" that exhibit the highest degree of comparability of their hours worked measures. In these 49 core countries, the following three conditions are fulfilled: (i) the surveys cover all hours worked producing any output counted in the National Income and Product Accounts (specifically, hours worked in self-employment or as unpaid family worker are also covered); (ii) the surveys ask about actual hours worked in a recent reference week in all jobs; (iii) the surveys cover the entire year.

Table 1 groups the core countries into low-, middle-, and high-income countries depending on which tercile of the world income distribution they belong to, as measured by GDP per adult in the Penn World Tables. As the first row of Table 1 shows, hours worked per adult (i.e. any individual aged 15 or older) amount to on average 28.5 weekly hours in the countries belonging to the poorest third of the world income distribution, 21.7 hours in countries belonging to the middle third, and only 19 hours in countries belonging to the richest third of the world income distribution. Thus, average hours worked per adult are 9.5 hours (or 50 percent) lower in rich than in poor countries. In Bick et al. (2018), we show that this cross-country pattern lines up very well with the time-series pattern of hours worked per adult in the US over the last century, as documented by Ramey and Francis (2009). We also show

Table 1: Average Hours Worked and Hours-Wage Gradients

| | Country Income Group | | |
|---|---|---|---|
| | Low | Middle | High |
| Average Hours Per Adult | 29.3 | 22.0 | 19.1 |
| Hours-Wage Gradient | −0.12 | −0.11 | −0.00 |

Note: This table reports average weekly hours worked per adult and the average hours-wage gradient by terciles of the country income distribution.

that the hours differences are statistically significant and hold for different demographic subgroups, namely by gender, education, and age.

To document how hours worked vary with individual wages within countries, we rely on wages in paid employment. There are two advantages to this. First, while workers in paid employment are clearly a selected group, their wages are relatively straightforward to measure by dividing monthly earnings by monthly hours. Secondly, paid employment closely resembles the market sector in our model below. We then run the following regression in each of our core countries:

$$log\left(h_i\right) = \alpha + \beta log\left(w_i\right) + \delta_1 age_i + \delta_2 {age_i}^2 + \varepsilon_i. \tag{1}$$

The resulting $\beta$-coefficients are shown in the second row of Table 1. For the low-income countries, the average hours-wage elasticity is negative with -0.12, and it stays negative and becomes only slightly larger for the middle-income countries with -0.11. For the high-income countries, by contrast, the hours-wage elasticity is on average exactly zero. For the richest nine countries in the sample, it is positive with a value of on average 0.08 (see also Figure 10 below, which shows the country-specific $\beta$-coefficients and thus also the increase in the $\beta$-coefficients within the group of high-income countries). Thus, we conclude that, in the majority of countries, low-wage individuals work more hours than high-wage individuals. However, in the richest countries in the sample the relationship turns around and high-wage individuals work more hours than low-wage individuals. Our cross-country results of the hours-wage elasticity turning from negative to positive with development is qualitatively and quantitatively in line with findings by Costa (2000) for the time-series of the US, starting in the 1890s.

In Bick et al. (2018), we show that the results presented here also hold for men and women separately, as well as for the sample of all workers, though the measurement of self-employed earnings varies greatly across countries. We also analyze the potential size of the division bias, which induces a negative relationship between hours and wages in the case of measurement error in hours. While we find some evidence for the division bias, we conclude that it is unlikely to substantially alter our findings.

## 3. Benchmark Model

We start with a framework that has the simplest number of features necessary to study the patterns of aggregate hours per adult and individual hours per worker shown in the previous section. The model is static with a unit measure of households that are heterogeneous in labor productivity, or alternatively their endowments of efficiency units. Each individual chooses how many hours to work. We interpret the static nature of the model and the absence of an extensive margin of working as representing an individual's average hours worked over the entire life-cycle. We will relax many of these assumptions in an extended model that aims to also replicate other salient features of the data we have not yet discussed.

The two key driving determinants of hours worked in the model, beside an indivdiual's own productivity level, are the need to satisfy a minimum level of consumption and a marginal tax on labor earnings used to pay transfers and for public goods, which we assume are rebated in a lump-sump fashion to households. Economies differ in two ways: first, an aggregate efficiency term, which determines the marginal product of each efficiency unit of labor, and second, the size of the tax-and-transfer system.

### 3.1. Setup

There is a unit measure of households. Each household consist of one member and households differ in their labor productivity $\varepsilon$, with $\log \varepsilon \sim N(0, \sigma_\varepsilon^2)$. Household's have Stone-Geary preferences, which feature a subsistence term in consumption $\bar{c}$ such that the income effect dominates the substitution effect:

$$u = \frac{(c-\bar{c})^{1-\gamma}}{1-\gamma} - \alpha \frac{h^{1+\frac{1}{\phi}}}{1+\frac{1}{\phi}}, \tag{2}$$

where in a dynamic setting $\frac{1}{\gamma}$ would represent the intertemporal elasticity of substitution and $\phi$ the Frisch labor supply elasticity.

Households choose hours $h$ to maximize Equation (2) subject to the following budget constraint

$$c = (1-\tau)we^{\varepsilon}h + T, \tag{3}$$

where $w$ denotes the equilibrium wage rate, $\tau$ a marginal tax on labor earnings and a lump-sum tranfer $T$. This transfer can be best interpreted as the amount of direct transfers to households and the amount of public goods provided by the government that are a substitute for private consumption expenditures.

Aggregate output $Y$ is linear in aggregate hours worked (in efficiency terms) and aggregate TFP $A$:

$$Y = A \int e^{\varepsilon} h(\varepsilon) d\varepsilon \equiv AH^{e}, \tag{4}$$

where we denote aggregate effective hours $\int e^{\varepsilon} h(\varepsilon) d\varepsilon$ by $H^{e}$. We assume that workers are paid their marginal product such that the economy wide equilibrium wage $w = A$. The government's budget constrainst is given by

$$T = A\tau H^{e} - G, \tag{5}$$

with $G$ representing government spending not valued by the households. In the following we denote $G$ as wasteful government spending.

Economies differ in two ways: first, in their aggregate efficiency $A$, and second, the size of the tax-and-transfer system $(\tau, T, G)$, which we assume to vary systematically with aggregate efficiency $A$.

### 3.2. Some Intuition

Assuming that $\gamma = 1$ – as typically done in the growth literature and in the literature on international differences in hours worked – and $\phi = \infty$, we can obtain closed form solutions to illustrate how this simple framework qualitatively can replicate the facts we documented before. By construction, through the lens of our model higher income countries will mostly be high-income countries because they have a higher TFP level $A$. As we will document further below, tax rates and transfers also vary systematically with a country's income level.

With $\gamma = 1$ and $\phi = \infty$, and using $w = A$, optimal hours are given by

$$h^* = \frac{1}{\alpha} - \frac{T - \bar{c}}{(1-\tau)Ae^{\varepsilon}}. \tag{6}$$

In the absence of transfers and a subsistence consumption requirement, i.e. $T = \bar{c} = 0$, the income and substitution effect cancel and hours are independent of aggregate and individual producitivity. When $\bar{c} > T$, the income effect dominates. As a consequence, high productivity workers will work shorter hours than low productivity workers. In contrast, when $T > \bar{c}$ the substitution effect dominates and high productivity workers will work longer hours than low productivity workers.

In low income countries, to a first-order approximation the subsistence consumption requirement will be the most important determinant. For illustrative purposes, we therefore assume that $\tau = T = G = 0$. Hence, the optimal hours choice in Equation (6) boils down to:

$$h^* = \frac{1}{\alpha} + \frac{\bar{c}}{Ae^{\varepsilon}}. \tag{7}$$

The key take-away from this equation is that the strength of the income effect induced by the subsistence consumption requirement is getting weaker as $A$ increases. In fact, in the limit when $A$ approaches infinity, the income effect and substitution effect will cancel. Hence, as $A$ increases, all individuals will reduce their hours worked consistent with the fact that aggregate hours decrease along the development process (which we interpret as increases in aggregate productivity). For a given $A$ however, workers with higher labor productivity $\varepsilon$ will work fewer hours. This generates the negative relationship between individual hours and individual wages in low income countries. Moreover, further abstracting from a tax-transfer system, increasing $A$ weakens that negative relationship. Eventually, as $A$ becomes large enough income and subsitution effects cancel and such that all workers will chose the same hours of work. Hence, this version can replicate the fall and leveling off in aggregate hours worked and the change in the correlation between individual hours worked and individual wages from negative to zero as $A$ increases.

Let us know consider the opposite case and assume that for very high income countries, the subsistence consumption requirement is irrelevant and we can re-write Equation (6):

$$h^* = \frac{1}{\alpha} - \frac{T}{(1-\tau)Ae^{\varepsilon}}. \tag{8}$$

Holding everything else constant, increases in transfers reduce individual and aggregate hours worked because now the subsitution effect dominates. Given this, higher taxes will reduce individual and aggregate hours. Hence, the higher taxes and transfers in rich countries provide an additional channel for dampening aggregate hours. At the same time, in the presence of such a transfer individual hours will be higher for individuals with higher labor productivity (holding everything else fixed again). This latter channel qualitatively can explain the positive correlation between wages and hours for high income levels.

As we document further below taxes and transfers are generally increasing in $A$ such the effects of an increase in $A$ are a bit more subtle than in the two simplifying cases considered above. To gain some more insights into this, we subsitute the government's budget constraint Equation (5) into the first order condition for hours Equation (6):

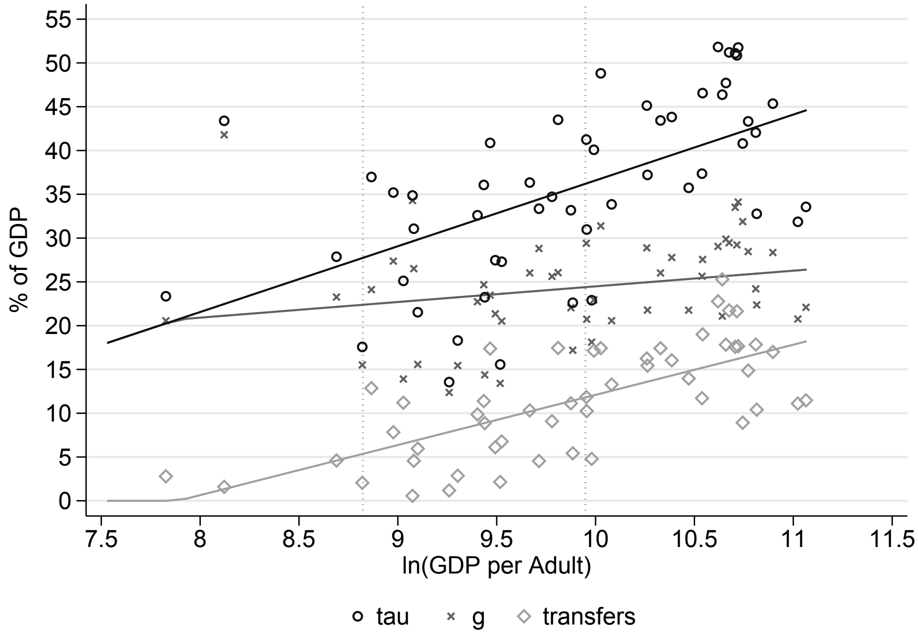
$$h^* = \frac{1}{\alpha} - \frac{\tau A H^e - (G + \bar{c})}{(1-\tau)Ae^{\varepsilon}}. \tag{9}$$

Taking the derivative of $h^*$ w.r.t. $A$, assuming that a) the income and substituion effect do not cancel, b) the aggregate effective hours $H^e$ are left unchanged, and denoting the derivatives of $\tau$ and $G$ w.r.t. $A$ as $\tau'$ and $G'$ yields:

$$\frac{\partial h^*}{\partial A} = -\frac{\tau'[Y - (G + \bar{c})]}{(1-\tau)^2 Ae^{\varepsilon}} + \frac{G'}{(1-\tau)Ae^{\varepsilon}} - \frac{G + \bar{c}}{(1-\tau)A^2 e^{2\varepsilon}}. \tag{10}$$

Note that we focus on the individual's hours assuming that aggregate effective hours are not affected by the individuals's choice and more broadly we hold aggregate effective hours constant. In this scenario, the first term shows that the higher taxes that we see in high TFP countries, i.e. $\tau' > 0$, have a dampening effect individual hours worked. That reflects the standard disincentive effect of distortionary income taxes. To the contrary, the second term shows that higher wasteful government spending that we see in high TFP countries is financed via higher hours. The last term shows that as TFP increases, it is easier to finance the given level of wasteful government expenditure and the subsistence consumption requirement which has a dampening effect on individual hours. The total effect will then depend on the quantitative strengths of each force and also on the general equilibrium change in aggregate effective hours.

Figure 1: Government Sector by Development




Source: IMF Government Statistics.

### 3.3. Taking the Model to the Data

As a crucial input into the model, we need estimates of taxes and transfers on the country level. To get country-specific measures on the linear income tax rate $\tau$ and the share of wasteful government expenditure $g$, where $g = G/Y$, we refer to the IMF Government Finance Statistics. We approximate $\tau$ with the share of total government expenditure over GDP, and $g$ with the share of government expenditure excluding social benefits over GDP, imposing a balanced budget as in the model. Figure 1 shows the country-specific rates, as well as linear approximations and the implied share of social benefits over GDP, which corresponds to the lump-sum transfers in the model. While data for poorer countries are scarce, and the data are rather noisy, the pattern that emerges is that both $\tau$ and $g$ increase with development, but the former faster than the latter. This leads to an increase in the welfare state by development: for the poorest countries, transfers are absent, and then they slowly increase to around 18% of GDP for the richest countries in the sample. We use the fitted values from this figure as input into the model.

We need to take a stance on different parameters. The first parameters are preference parameters in the utility function and are fairly standard. We maintain the assumption of log utility over consumption ($\gamma = 1$) and set the Frisch elasticity to 1, the lower end of estimates that also reflect extensive margin adjustments. The distribution of labor productivity is taken from the US estimates in Flodén and Lindé (2001), but is for now assumed to capture permanent differences across individuals.

Our calibration strategy is as follows. First, we will construct an "average" low- and high-income country, i.e. an artificial country with the average hours worked per adult, output per adult and tax-transfer-system (as obtained from the IMF government statistics) over the set of low- and high-income countries, respectively. For the average high income country, we normalize TFP to $A^{rich} = 1$. We then calibrate the value of TFP in the average low income country $A^{poor}$ and the value of subsistence consumption $\bar{c}$ such that we match output per adult and hours worked per adult in the average low-income relative to the average high-income country. This calibration strategy implies $A^{poor} = 0.064$ and $\bar{c} = 0.008$. We set the disutility of leisure at $\alpha = 10$ so that individual hours worked do not exceed 112 hours after normalization. This calibration allows to go after our motivating question: by how much do income effects and the tax-transfer system account for the difference in hours worked per adult and the change in the wage-hours correlation between low and high income countries. In addition, we can contrast our model prediction with two untargeted moments: the wage-hours correlation in the average low- and high-income country.

However, we are not only interested in these comparisons for the average low- and high-income country, but more broadly what happens along the development process. We conduct the following exercise. In line with Figure 1, we assume that the tax-transfer functions increase linearly in TFP, where the slope is determined by the differences in the tax-transfer system and TFP between the average low- and high-income country. Note that when the implied transfers are negative for a country, we set them to be zero. For a given TFP level and thus also tax-transfer system, we can now solve for optimal hours on the individual and aggregate level in equilibrium. We then compare hours per adult and the wage-hours correlation between simulated countries in the model and the data who have the same level of output per adult. That exercise is suggestive of the model's ability to generate trends in hours worked and the change in wage-hours correlation along the development process.

### 3.4. Results of the Benchmark Model

Figure 4 shows the model results for aggregate hours worked (blue line) plotted against the data (red dots). The green crosses show the targets of average hours worked per adult in poor and rich countries, which the model hits perfectly.

Figure 2: Benchmark Results: Aggregate Hours Worked

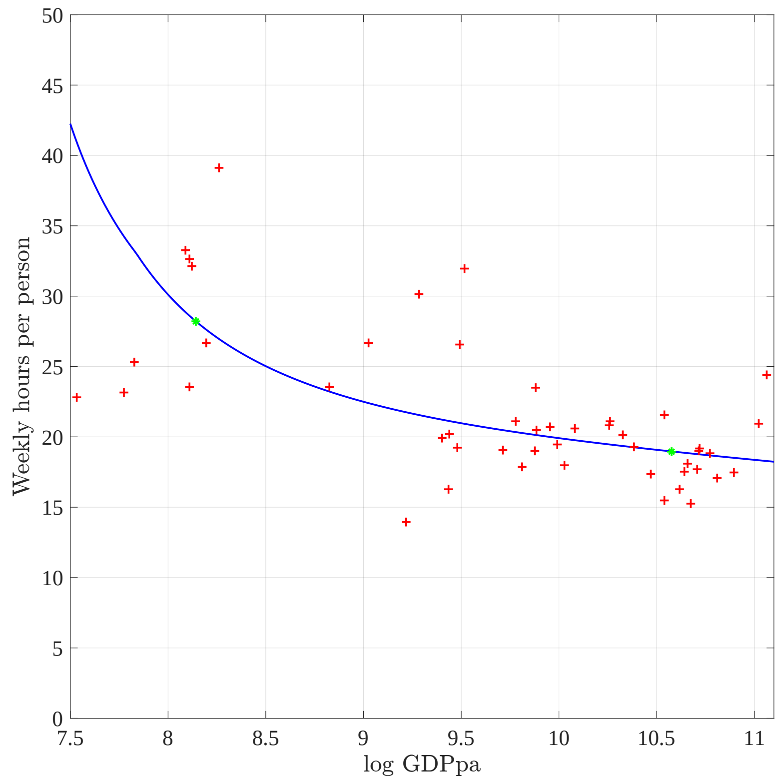



Figure 5 then turns to the model prediction and data points relating to the hours-wage elasticity within a country. This statistic is not targeted in the calibration exercise.

### 3.4.1. Decomposition

To understand the relative roles of income effects and taxes and transfers in generating the observed patterns, we do the following decomposition exercise. First, we shut down the income effect by setting $\bar{c} = 0$. This is indicated by the dashed "no income effect"-line. Second, we shut down cross-country variation in taxes and transfers by leaving them at the average level of poor income countries. This is indicated by the dotted "no fiscal variation"-line. Figures 4 and 5 show these results, as well as the benchmark model results, for average hours worked per adult and within-country hours-wage elasticities, respectively.

Figure 3: Benchmark Results: Within-Country Hours-Wage Elasticity

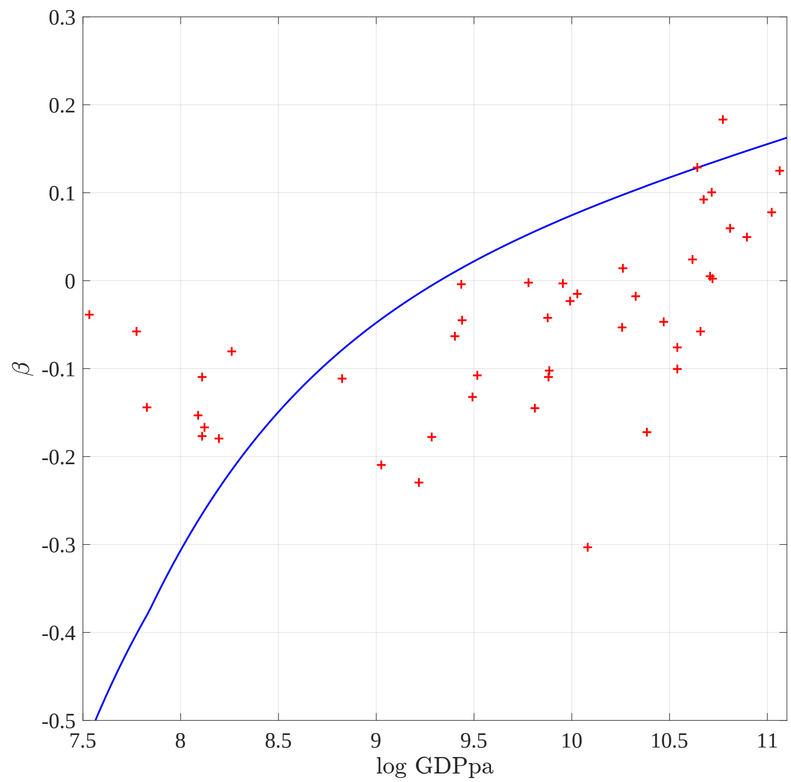


Figure 4: Decomposition of Benchmark Results: Aggregate Hours Worked

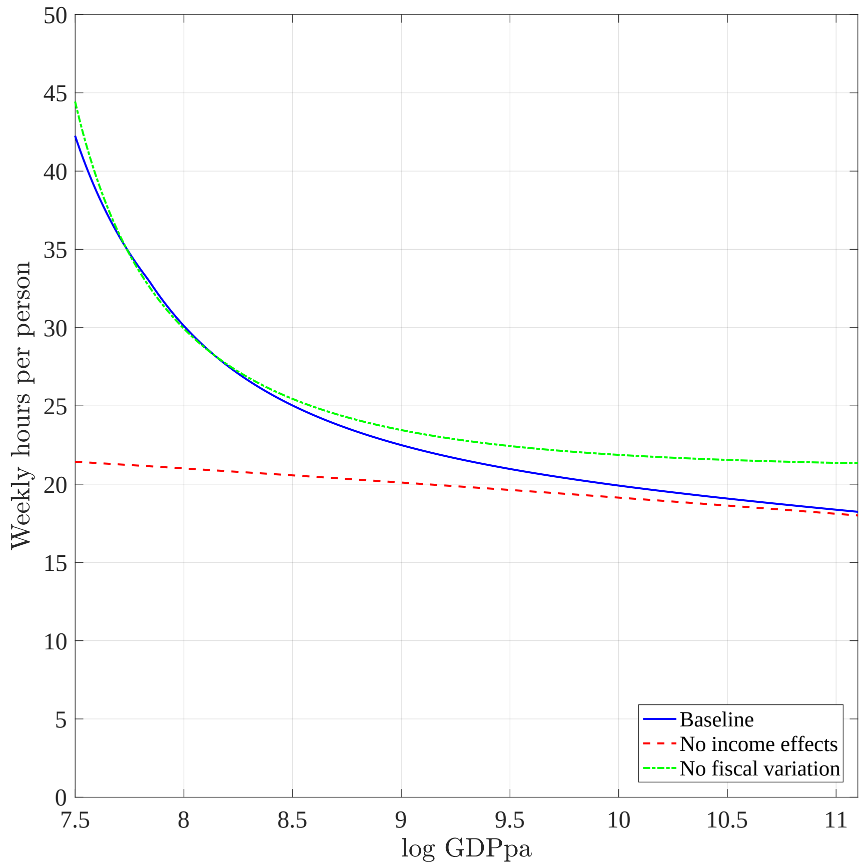
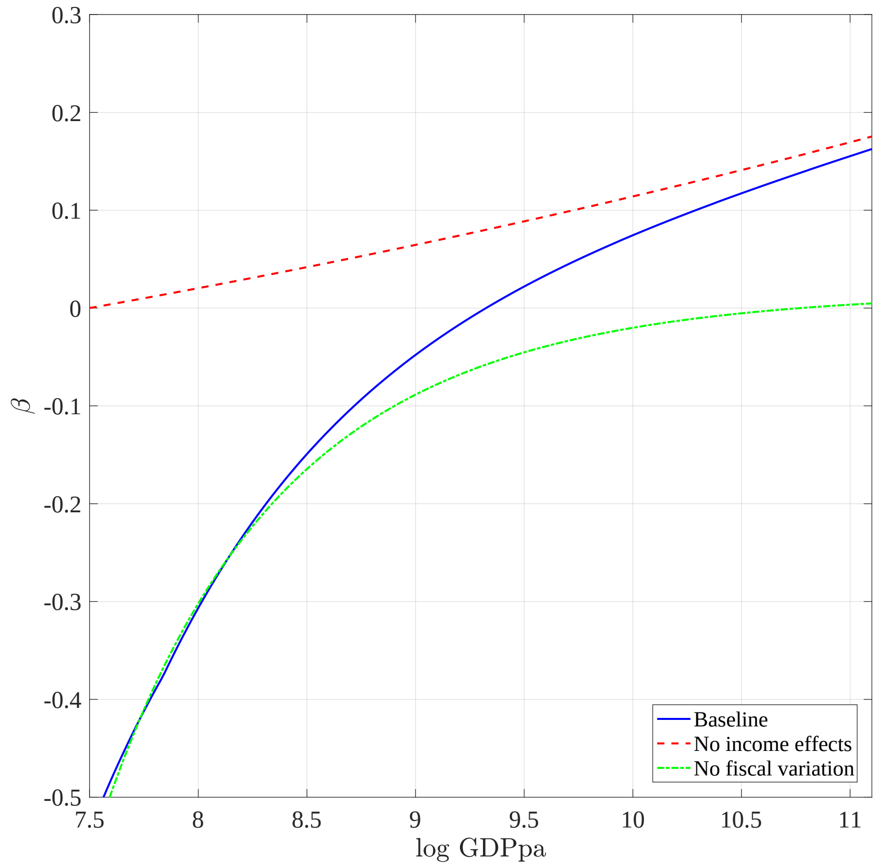


Figure 5: Decomposition of Benchmark Results: Within-Country Hours-Wage Elasticity



## 4. Extended Model

We now extend the simple benchmark model to include additional determinants of labor supply at the individual and aggregate level. In particular we incorporate an extensive in addition to the intensive margin of labor supply, capital accumulation, self employment and household labor supply decisions. We then calibrate the model and use it to revisit the question of how income effects and tax-and-transfer systems determine how hours worked vary with income.

### 4.1. Sectors

We start with the description of the market and traditional sector. The key distinction between these two sectors are the different production technologies. By contrast, we consider the output of both sectors as perfect substitutes, with the price being normalized to one. While the market sector resembles a standard competitive sector that offers paid employment, the traditional sector represents "push self-employment," which is prevalent in poor countries.[1]

**Market sector** The market sector is a competitive sectors with the Cobb-Douglas production function

$$Y_M = A_M K_M^{\theta_M} L_M^{1-\theta_M}, \tag{11}$$

where $A_M$ is the aggregate market sector productivity, and $K_M$ and $L_M$ are aggregate capital and aggregate effective labor used as input in the market sector.

**Traditional sector** The traditional sector is characterized by a constant elasticity of substitution production function. Each family working in the traditional sector can only use own raw labor and own capital as input. The traditional sector is thus meant to capture the partial absence of land, labor, and capital markets in developing countries (see e.g. Jayachandran, 2006, or Karlan et al., 2014). Output per family working in the traditional sector is

$$y_T = A_T \left[\theta_T (l+k)^{\rho} + (1-\theta_T) n^{\rho}\right]^{1/\rho}, \tag{12}$$

[1]The structural transformation literature instead distinguishes between the three sectors agriculture, manufacturing, and services, which produce different products that are imperfect substitutes, but have the same production technologies with possibly different sectoral productivities. Feng et al. (2018) also rely on the distinction between a traditional and a market sector; in their model, which does not feature capital, the labor market in the traditional sector is frictionless, while there are search frictions in the market sector.

where $A_T$ is the aggregate traditional sector productivity, and $k$ and $n$ are family capital and family hours worked. Each family is endowed with $l$ units of non-tradable capital that can be used in production in the traditional sector. This makes working in the traditional sector always a viable option.[2] The elasticity of substitution between capital and labor in the traditional sector is equal to $\frac{1}{1-\rho}$.

### 4.2. Families and Individuals

There is a continuum of families of mass 1 in each country, and a continuum of individuals of mass 1 in each family. We assume perfect insurance within a family, and no insurance across families (see Heathcote et al., 2014). Families are meant to capture different kinds of informal insurance networks within a country, which might exist not only within families, but also within villages or other groups (see e.g. Townsend, 1994, and Fafchamps and Lund, 2003). Families differ in their market productivity $z$,[3] which evolves stochastically, as well as in their capital $k$, which is an endogenous variable. Individuals within the family differ in their individual fixed disutility of work $\lambda$. The instantaneous utility function of an individual is

$$u(\tilde{c},\tilde{n};\lambda) = \frac{(\tilde{c}-\bar{c})^{1-\gamma}}{1-\gamma} - \alpha\frac{\tilde{n}^{1+\sigma}}{1+\sigma} - \bar{u}_S\lambda\, I_{\tilde{n}>0}, \tag{13}$$

where $\tilde{c}$ is individual consumption, $\bar{c}$ is subsistence consumption, $\bar{u}_S$ is the utility cost of working in sector $S$, which can potentially differ between the market and the traditional sector, and $I_{\tilde{n}>0}$ is an indicator equal to 1 if the individual works (in what follows, variables $c$ and $n$ with a tilde refer to the individual level, and without a tilde to the family level). As usual in the macroeconomic literature, we assume that preferences are separable in consumption and labor.

We assume that all members of a family have to work in the same sector. Each family is headed by a family head who maximizes the present discounted value of the joint utility of all household members, and whose decisions are incentive compatible. Family income equals traditional sector output if the family works in the traditional sector, and the hourly wage times effective family hours worked (i.e. family hours multiplied with market productivity $z$) plus capital income if the family works in the market sector. The family maximization problem is further detailed in Subsection 4.5.

[2] In the agricultural sector in poor countries, one can think of $l$ as a “backyard”.

[3] Similarly, Porzio and Santangelo (2017) assume that human capital does not matter in the agricultural sector, but only in the non-agricultural one.

### 4.3. The Government

The government applies a linear income tax rate $\tau$ to household income. A fraction $g$ of government revenues goes to wasteful government spending, and the rest is redistributed as lump-sum transfers $\Upsilon$ to households, such that the budget is balanced each period:

$$\Upsilon = (\tau - g)(Y_T + Y_M) \tag{14}$$

### 4.4. Market clearing

The competitive market sector clears, such that

$$L_M = \int zn(z,k) \cdot 1_{\{S(z,k)=M\}} d\mu_{z,k}, \tag{15}$$

$$K_M = \int k \cdot 1_{\{S(z,k)=M\}} d\mu_{z,k}. \tag{16}$$

### 4.5. Solving the Family's Maximization Problem

The family head faces a two-stage maximization problem. In a first step, she chooses the sector $S$, as well as family hours $n$ and family consumption $c$ and thus capital for the next period $k'$. In a second step, given family hours and consumption, she chooses individual hours $\tilde{n}$ and consumption $\tilde{c}$. We solve the maximization problem by backward induction.

**Second stage** Given family hours and consumption, as well as the sectoral choice for the family, the second step maximization problem amounts to

$$\begin{aligned} \max_{\{\tilde{c}(\cdot),\tilde{n}(\cdot)\}} \quad & \int \left[ \tfrac{(\tilde{c}(\lambda)-\bar{c})^{1-\gamma}}{1-\gamma} - \alpha \tfrac{\tilde{n}(\lambda)^{1+\sigma}}{1+\sigma} - \bar{u}_S \lambda I_{\tilde{n}>0} \right] dF \\ \text{s.t.} \quad & \int \tilde{c}(\lambda) dF = c \\ & \int \tilde{n}(\lambda) dF = n \end{aligned} \tag{17}$$

The first order condition for consumption implies perfect consumption risk sharing within the family, i.e. $\tilde{c}(\lambda) = c \; \forall \lambda$. Also, due to the separability of disutility arising from working at the extensive and intensive margin, there is no variation within the family in optimal hours worked conditional on working. The optimal hours function thus can be expressed as

$$\tilde{n}(\lambda) = \begin{cases} \tilde{n}^* > 0 & \text{for } \lambda \leq \lambda^* \\ 0 & \text{otherwise.} \end{cases} \tag{18}$$

The family head's problem therefore reduces to determining a threshold level $\lambda^*$: all family members with a disutility of work below this threshold level work the same positive hours $\tilde{n}^*(\lambda^*) = \frac{n}{F(\lambda^*)}$, and all family members with a disutility above this threshold level do not work. Given family hours $n$, individual hours worked are decreasing in the threshold level, $\frac{\partial \tilde{n}^*}{\partial \lambda^*} < 0$. Plugging $\tilde{n}^*(\lambda^*)$ into the utility function, the head's problem becomes

$$\max_{\lambda^*} \quad \left[ -\alpha \tfrac{\tilde{n}^*(\lambda^*)^{1+\sigma}}{1+\sigma} \int_0^{\lambda^*} dF - \bar{u}_S \int_0^{\lambda^*} \lambda dF \right]. \tag{19}$$

Taking the first order condition and applying the chain rule and the Leibniz rule leads to

$$\alpha \frac{\tilde{n}^*(\lambda^*)^{1+\sigma}}{1+\sigma} f(\lambda^*) + \bar{u}_S \lambda^* f(\lambda^*) = \alpha \tilde{n}^*(\lambda^*)^{\sigma} \tilde{n}^{*\prime}(\lambda^*) F(\lambda^*). \tag{20}$$

The first term on the LHS of this equation equals the marginal disutility from working $\tilde{n}^*$ hours for the new workers of mass $f(\lambda^*)$ that start working if the optimal threshold level $\lambda^*$ is marginally changed. The second term of the LHS adds to this the fixed utility cost incurred by these workers. These marginal utility losses of the new workers are equated with the marginal utility gain the already existing workers of mass $F(\lambda^*)$ enjoy because of their decrease in hours worked, which is expressed on the RHS. The equation thus implicitly defines the optimal threshold level as a function of family hours, $\lambda^* = \lambda(n)$. Plugging this solution into the family utility function gives (see Constantinides, 1982)

$$u(c,n) = \frac{(c-\bar{c})^{1-\gamma}}{1-\gamma} - \alpha \frac{n^{1+\sigma}}{1+\sigma} \left(F(\lambda^*(n))\right)^{-\sigma} - \bar{u}_S \int_0^{\lambda^*(n)} \lambda dF. \tag{21}$$

**First stage** In the first stage, the family head solves the following dynamic maximization problem of the family:

$$V(z,k) = \max_{c,n \geq 0, k' \geq 0, S \in \{T,M\}} \quad [u(c,n) + \beta \zeta \mathbb{E}_{z'} [V(z',k')|z]] \tag{22}$$

$$\text{s.t.}\quad c+k'-(1-\delta)k=(1-\tau)y+\Upsilon$$

$$y=\begin{cases} A_T\left[\theta_T(l+k)^{\rho}+(1-\theta_T)n^{\rho}\right]^{1/\rho} & \text{if } s=T \\ wzn+rk & \text{if } s=M \end{cases} \tag{23}$$

where $\zeta$ is the stochastic survival probability. If the family works in the traditional sector $T$, it uses own capital and labor as inputs into the traditional sector production function, and receives the output as income. If the family works in the market sector $M$, it rents own capital and labor to the competitive market sector, its labor earnings amount to $wzn$, and its capital income to $rk$.

### 4.6. The Process of Development

We assume that two sets of variables differ exogenously by development: first, the aggregate productivities in the market and traditional sector, and secondly, the variables governing the welfare state. We solve steady-states for each level of development.

During the development process, the market sector productivity $A_M$ increases exogenously. In addition, we assume that the two sectoral productivities are linked by the following functional form:

$$log(A_T)=\phi_0+\phi_1 log(A_M). \tag{24}$$

With $\phi_1>0$, productivity in the market sector increases faster than productivity in the traditional sector over the development process.

Regarding the variables governing the welfare state, we show below that the linear tax rate $\tau$ increases faster with development than wasteful government spending $g$ in the data, resulting in increasing transfers $\Upsilon$, also as a function of total output.

#### 4.6.1. Some Intuition

How do hours across and within countries change over the development process? By definition, household incomes are higher in rich than in poor countries, driven by increasing total factor productivities in both sectors by development. Due to the Stone-Geary preferences, this leads to decreasing aggregate hours worked in development across countries, and to decreasing individual hours worked in wages within countries. However, in how far the aggregate decrease arises in the extensive or intensive margin, and how fast both decreases level off, depends on the model calibration. For the aggregate decrease in hours, the fixed costs of working $u_S$ and the Frisch elasticity governed by $\sigma$ matter for the predicted quantities, while for the decrease in hours within countries, the level of subsistence consumption $\bar{c}$ is decisive. The increasing transfers $\Upsilon$ in development are an additional force for lower hours in rich than in poor countries, and for a flattening or even turning of the hours-wage elasticity within a country by development. While in poor countries low-wage individuals need to work long hours in order to survive, in rich countries they can rely on the welfare state.

If capital and labor are complements in the traditional sector, governed by the parameter $\rho$, then individuals with low levels of capital optimally provide low hours in the traditional sector. Thus, while generally the model creates decreasing hours in development, within the traditional sector there can be an opposing force: higher average family capital with development could lead to increasing hours worked in the traditional sector.

The development process also affects the sectoral choices of families. The increasing *relative* market sector productivity $\frac{A_M}{A_T}$ with development increases the attractiveness of working in the market sector in rich relative to poor countries. Thus, the model endogenously generates a decreasing share of workers in the traditional sector. Next to the relative productivites, the sectoral choices of families depend however also on the relative fixed costs of working in the two sectors $\bar{u}_M$ and $\bar{u}_T$, which are assumed to be constant across countries, and on the two family level variables of market productivity $z$ and capital $k$.

## 5. Quantitative Analysis of Extended Model

We take some parameters of the model from the literature, and calibrate the remaining parameters to data coming from the countries belonging to the poorest third of the world income distribution. Focusing on the poor countries allows us to pin down the size of the subsistence consumption parameter, as well as the relative productivity in the market vs. traditional sector.[4]

[4] Subsistence consumption and the traditional sector both play almost no role in the rich countries.

## 5.1. Model Simplifications and Normalizations

We currently solve a version of the model with two simplifications: First, we assume that market sector productivity differences across families are permanent. Secondly, we assume a small open economy with an exogenous interest rate, and set the capital in the market sector equal to $K_M = 1$.

We assume that the individual fixed utility cost of working is uniformly distributed with $\lambda \sim U(0,1)$, which allows us to solve the second stage of the family head maximization problem in closed form. Last, we normalize $A_M^{poor}$, i.e. the aggregate market sector productivity in countries belonging to the poorest third of the world income distribution, to 1, and set the exogenous "backyard"-endowment to $l = 1$.

## 5.2. Parametrization

Table 2 shows the values of pre-assigned parameters. The first four parameters are preference parameters in the utility function and are fairly standard. We assume a weight on the disutility of labor of 1, risk aversion of 1, a Frisch elasticity of 0.5, and an annual discount factor of 0.96. The distribution of market sector productivity is taken from the US estimates in Flodén and Lindé (2001), but is for now assumed to capture permanent differences across families. The survival probability is set to 0.98. The next three parameters refer to the two sectors. We set $\phi_1 = 0.2$, which is close to the value of $\phi_1 = 0.26$ calibrated in Feng et al. (2018) based on relative price data.[5] We assume that the capital shares in both sectors are equal to $\frac{1}{3}$. This is done because Gollin (2002) provides evidence that, adjusted for self-employed income and sectoral composition, labor shares are remarkably similar across countries. We set the elasticity of substitution between capital and labor in the traditional sector to 0.5, implying that capital and labor are complements in the traditional sector. We choose to make them complements based on experimental evidence that shows that very poor individuals in rural areas in developing countries increase their hours worked when supplied with productive assets like a cow or goats, which indicates complementarity in production (see Bandiera et al., 2017, and Banerjee et al., 2015). Last, we set the interest rate to 0.14 and the depreciation rate to 0.08.

[5]Note, though, that while our empirical definition of the market and traditional sector is identical to theirs, they assume that output from both sectors are non-perfect substitutes, with an elasticity of substitution of 3.

Table 2: Model Parameters

| | Parameter | Value |
|---|---|---|
| $\alpha$ | disutility of labor | 1 |
| $\gamma$ | risk aversion | 1 |
| $\sigma$ | curvature on hours | 2<br>(Frisch elast. of 0.5) |
| $\beta$ | discount factor | 0.96 |
| $z$-process | distribution of fam. productivity | Flodén/Lindé (2001) |
| $\zeta$ | survival probability | 0.98 |
| $\phi_1$ | rel. prod. growth<br>in $T$ vs. $M$ sector | 0.2 |
| $\theta_T, \theta_M$ | capital shares in $T/M$ sectors | $\frac{1}{3}$ |
| $\rho$ | elasticity of substitution<br>between $n$ and $k$ in $T$ sector | -1<br>(elasticity 0.5) |
| $r$ | interest rate | 0.14 |
| $\delta$ | depreciation rate | 0.08 |

### 5.3. Measurement of Traditional and Market Sector

The defining characteristic regarding the traditional vs. the market sector in the model is the production process, and especially the use of only own capital and labor as inputs in the traditional sector. As an empirical proxy of working in the traditional sector, we focus on self-employed individuals with low education.[6] All other working individuals are assigned to the market sector.[7] The empirical patterns we document here are very similar if we equate the traditional sector with the agricultural sector, and the market sector with the manufacturing and services sectors. Conceptually, we think however that agriculture in rich countries is better represented as a market sector, and some self-employment without access to factor markets in poor countries might occur in the service sector (shoe polishing, etc.).[8]

Table 3 shows in the first two rows the average hours per worker in the traditional and the

[6] For some countries, we can additionally control for not having any employees. If we do that, results for these countries are almost unchanged. For most countries, the variable of the number of employees is not available.

[7] We thus follow the definition used in Feng et al. (2018).

[8] Storesletten et al. (2017) present a model of structural transformation in which only the agricultural sector is split into a traditional and a market sector.

market sector, separately for the three country income groups. Looking across columns, we find that hours worked per worker are 3.6 hours higher in rich than in poor countries in the traditional sector. By contrast, they are 11.5 hours lower in rich than in poor countries in the market sector. Thus, hours per worker are strongly decreasing in development in the market sector, and slightly increasing in the traditional sector. As a result, looking across rows, for the poor and middle-income countries hours are markedly lower in the traditional than in the market sector, namely by 11 and 5.3 weekly hours, respectively. Only for the rich countries are hours higher in the traditional sector than in the market sector, with a difference of 4.2 hours.

The last row of Table 3 then shows the share of workers in the traditional sector: In the poor countries, almost two thirds of workers (64.6%) work in the traditional sector. This share is rapidly decreasing to 19.9% in the middle-income countries, and only 5.9% in the high-income countries. Thus, over the development process, workers shift quickly from the traditional into the market sector.

Taking the patterns of sectoral hours worked per worker and sectoral shares of workers together, it becomes clear that the increase of 2.7 weekly hours worked per worker between low- and middle-income countries documented in Table 1 does not arise because of an increase in sectoral hours worked per worker, but is due to a compositional effect: hours are markedly lower in the traditional than in the market sector in both low- and middle-income countries, and the substantial decrease in the share working in the traditional sector between low- and middle-income countries thus causes an increase in average hours worked per worker. Thus, the increasing part of the hump in hours worked per worker over development is driven by this compositional effect. The decreasing part between middle- and high-income countries, by contrast, is driven by a strong decrease in market hours per worker between these two country-income groups, with the large majority of individuals working in the market sector in both country-income groups.

### 5.4. Calibration

There are four remaining parameters that we need to calibrate, namely the mean disutilities of working in the market and traditional sectors, the relative productivity of both sectors, and the subsistence consumption term. Table 4 shows the four targets from the poor countries that we use to pin down these parameters, namely the average employment rate, the share of workers in the traditional sector, the relative hours of workers in the market vs. the traditional

Table 3: Sectoral Hours Worked and Sectoral Shares

| | Country Income Group | | |
|---|---|---|---|
| | Low | Middle | High |
| Traditional Sec. Hours | 35.4 | 36.8 | 39.2 |
| Market Sec. Hours | 46.4 | 42.1 | 34.9 |
| Traditional Sec. Share | 64.6 | 19.9 | 5.9 |

Table 4: Calibration Targets

| Parameter | | Target | |
|---|---|---|---|
| $\bar{u}_M$ | mean disutility of working in $M$ sector | avg. ER | 0.746 |
| $\bar{u}_T$ | mean disutility of working in $T$ sector | share of workers in $T$ sector | 0.643 |
| $\phi_0$ | relative productivity of 2 sectors (impl. $A_T^{poor}$) | relative hours per worker in two sectors | 1.308 |
| $\bar{c}$ | subsistence term | within-country hours-wage elas. | -0.122 |

sector, and the within-country hours-wage elasticity.

The average employment rate in the poor countries amounts to 74.6%, and the share of workers working in the traditional sector to 64.3%.

Table 5 shows the resulting calibrated parameters. Working in the market sector brings with it a substantially higher utility cost than working in the traditional sector: the calibrated disutility is almost four times higher. Total factor productivity in the traditional sector in poor countries amounts to $A_T^{poor} = 0.503$, and is thus almost exactly half the size of total factor productivity in the market sector (normalized to 1). Note that the productivity gap between both sectors increases over the development spectrum. Last, the subsistence term amounts to annual USD 673. This corresponds to USD 1.83 per day, and thus lies between the values of USD 1 to 2 per day often assumed by development agencies.

Table 5: Calibration Results

| Parameter | | Value |
|---|---|---|
| $\bar{u}_M$ | mean disutility of working in $M$ sector | 2.928 |
| $\bar{u}_T$ | mean disutility of working in $T$ sector | 0.726 |
| $\phi_0$ | relative productivity of 2 sectors (impl. $A_T^{poor}$) | -0.687 ($A_T^{poor} = 0.503$) |
| $\bar{c}$ | subsistence term | 0.137 (USD 673) |

## 6. Results of Extended Model

After calibrating the model to data from poor countries, we let the sectoral productivities as well as the size of the welfare state exogenously increase in order to simulate richer countries. We then ask in how far the model can explain the shape of employment rates and hours worked per worker, as well as of the hours-wage elasticity, over the development process. Last, we decompose the role that the welfare state vs. aggregate productivities in conjunction with preferences play in generating the patterns.

As a country-specific measure of the market sector productivity, we take country-specific total factor productivity from the Penn World Tables. We generate a quadratic fit of this TFP measure against the logarithm of GDP per adult, and use the predicted total factor productivity from this regression as the country-specific $A_M$ input into the model. [9]

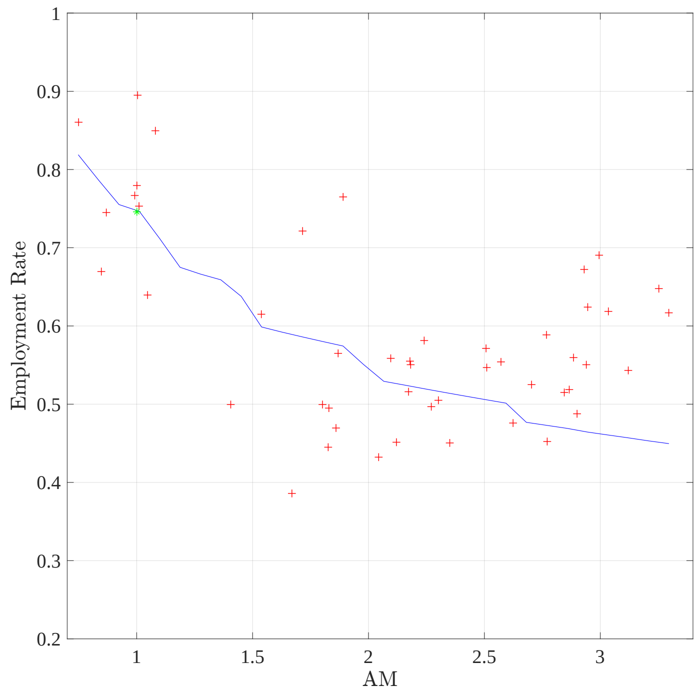
### 6.1. Results on Hours Worked across Countries

Figure 6 shows the actual employment rates in the data in red dots, and the model predicted employment rate in the blue line, both plotted against total factor productivity in the market sector $A_M$.[10] The green dot shows the targeted average employment rate in the poor countries, which the model fits perfectly. The model generates a strong decrease in

[9]The smoothing is done due to some anomalies in the PWT observations, see also Imrohoroglu and Üngör (2016).

[10]Note that we plot all variables against $A_M$ rather than the logarithm of GDP per adult, since we do not yet endogenize capital in the market sector, and thus model-predicted GDP measures are off.

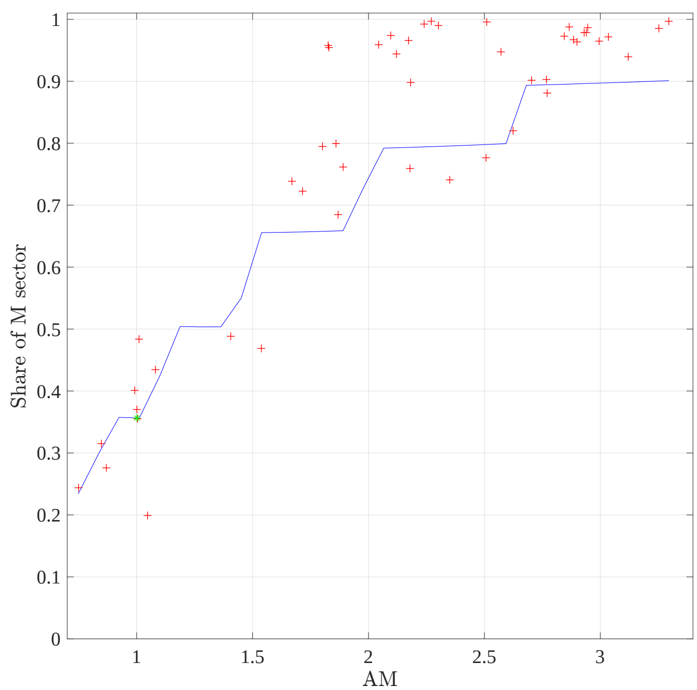
Figure 6: Employment Rates in Data and Model




the employment rate between low- and middle-income countries, as also observed in the data. While it does not capture the small increase in the employment rate between middle- and high-income countries, the model-predicted decrease in the employment rate levels off in the richer countries. Intuitively, as countries grow richer, the income effect caused by subsistence consumption grows weaker, and thus employment rates rapidly fall off. This preference-induced decrease leads to flat employment rates in the limit, when the subsistence term does not matter anymore even for the poorest individuals in a country. Thus, the model generates the decrease at a decreasing rate as observed in the data. A second model feature that leads to a decrease in employment rates by development is the increasing size of the welfare state. In rich countries, low-productivity families can afford to drop out of the labor market, which is not an option in poor countries, and more high-disutility indivdiuals can afford not to work. The relative role of these two factors is further explored below.

Figure 7 shows the share of workers employed in the market sector in model and data. The model matches the increase in the share over the development process very well, only slightly underpredicting the share of workers in the market sector in rich countries. The

Figure 7: Sectoral Employment Shares in Data and Model




driving force behind the increase in the market share is the increasing gap in the two sectoral productivities.

Turning to the intensive margin of labor supply, Figure 8 shows sectoral hours per worker in the market sector (left panel) and the traditional sector (right panel). The model predicts a slight and almost parallel decrease in hours in both sectors. Thus, it fails to predict the slight increase in hours in the traditional sector, but most importantly also the strong decrease in hours in the market sector. The strong income effect caused by subsistence consumption plays out almost exclusively in the extensive margin of labor supply, rather than the intensive margin.

As a result of the failure of the model to replicate the strong decrease in market hours observed in the data, total hours worked per worker are also not matched well by the model, see Figure 9. The model generates part of the increase in hours per worker between low- and middle-income countries because of its success in matching sectoral employment shares. However, it does not generate any of the decrease in hours per worker between middle- and high-income countries because it does not match the decrease in market hours.

Figure 8: Sectoral Hours Worked in Data and Model

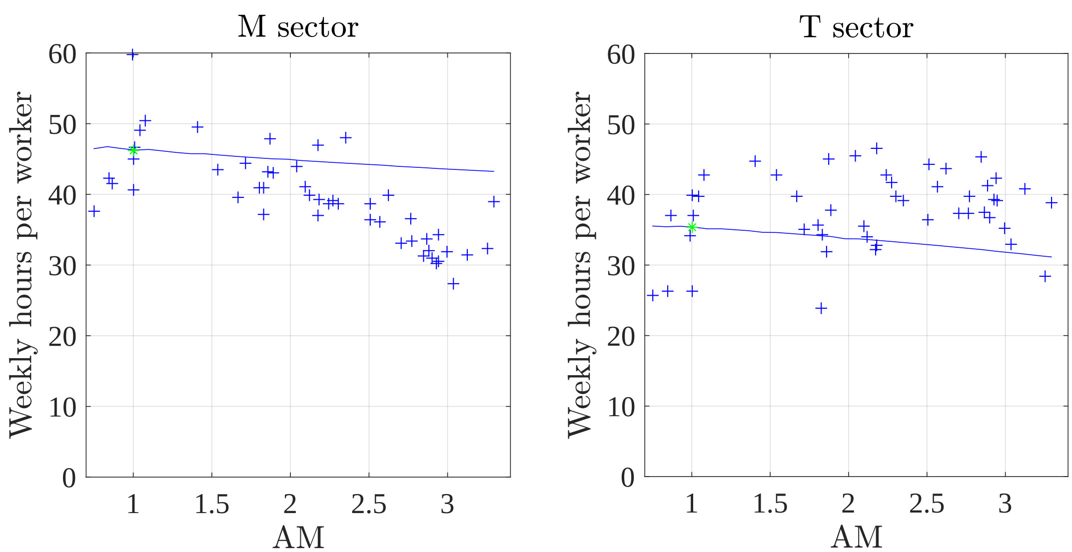


Figure 9: Hours Worked per Worker in Data and Model

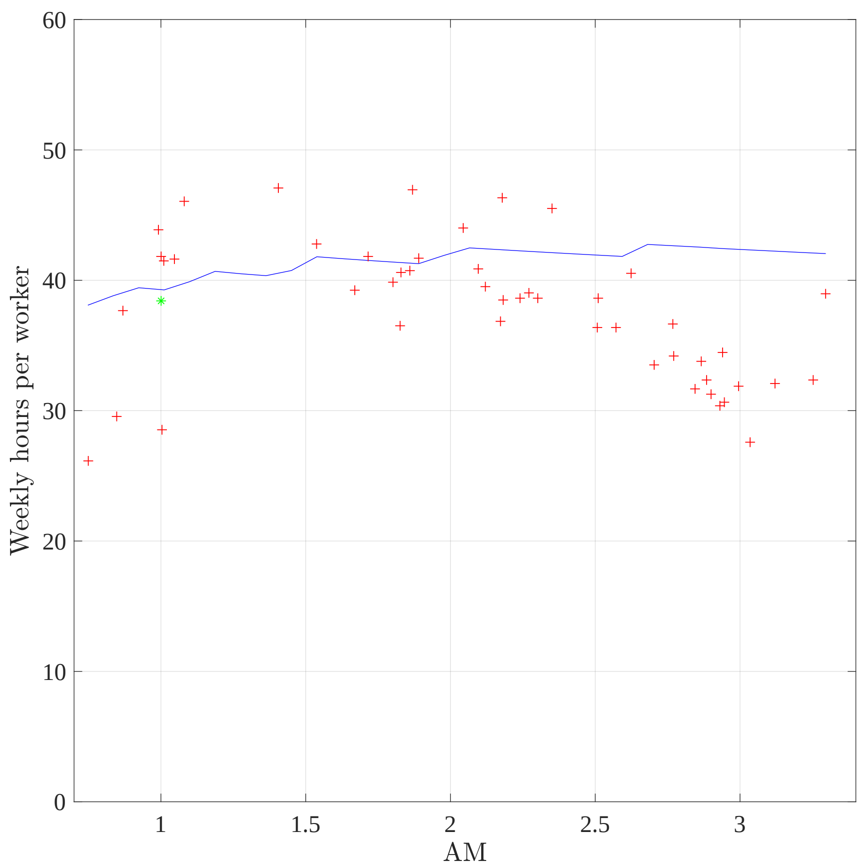
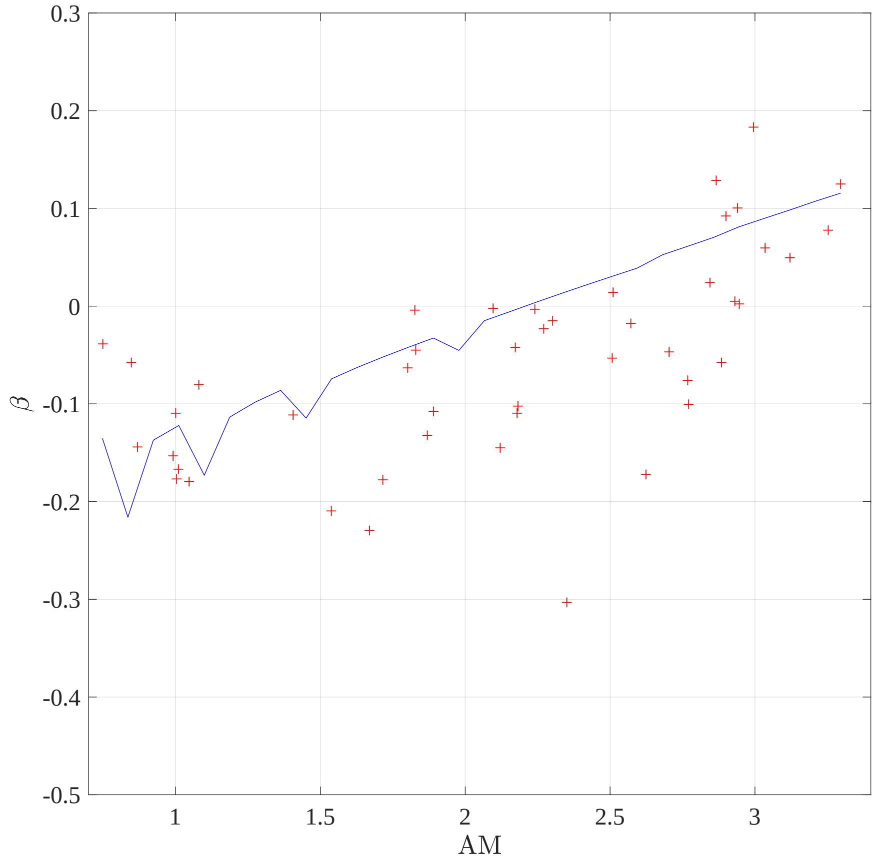


Figure 10: Hours-Wage Elasticity in Data and Model




### 6.2. Results on Hours Worked within Countries

Figure 10 shows the estimated hours-wage elasticity in each country, again plotted against market sector aggregate productivity $A_M$. In line with the data, which refers to workers in paid employment, we estimate the elasticity in the model for workers in the market sector. The model endogenously generates the turning of the hours-wage elasticity from negative in poor countries to positive in rich countries. As in the data, the hours-wage elasticity in the model amounts to around 0.1 for the richest countries in the sample. However, the predicted increase in the hours-wage elasticity by development in the model is somewhat too fast: for the middle-income countries, the model predicts negative elasticities, but smaller in absolute value than in the data. While in the data the increase in the hours-wage elasticity by development is convex, it is almost linear in the model.

### 6.3. The Role of Fiscal Policies

There are two exogenous sources of variation in the model: the size of the welfare state, and the aggregate sectoral productivities, which matter in conjunction with the preferences. To understand the relative importance of these two forces for the results, we use the calibrated model and exogenously change the aggregate sectoral productivity as in the baseline results, but keep the fiscal policy parameters at the average level of low-income countries for all countries.

Not surprisingly, the fiscal policies do not matter for the sectoral choice of workers, and thus the shares of workers in both sectors are not affected at all in this exercise. However, fiscal policies are important for labor supply along both margins. Figure 11 shows that both the decrease in employment rates by development and the decrease in sectoral hours by development would be smaller without the increasing welfare state. In fact, without the increase in the welfare state sectoral hours are almost completely flat by development, while only around 20% of the overall decrease in the employment rates is due the welfare state.

Last, Figure 12 shows that without an increasing size of the welfare state by development, the hours-wage elasticity stays negative also for the richest countries. Thus, the increasing size of the welfare state with development is a key ingredient to generate the turning of the hours-wage elasticity from negative to positive.

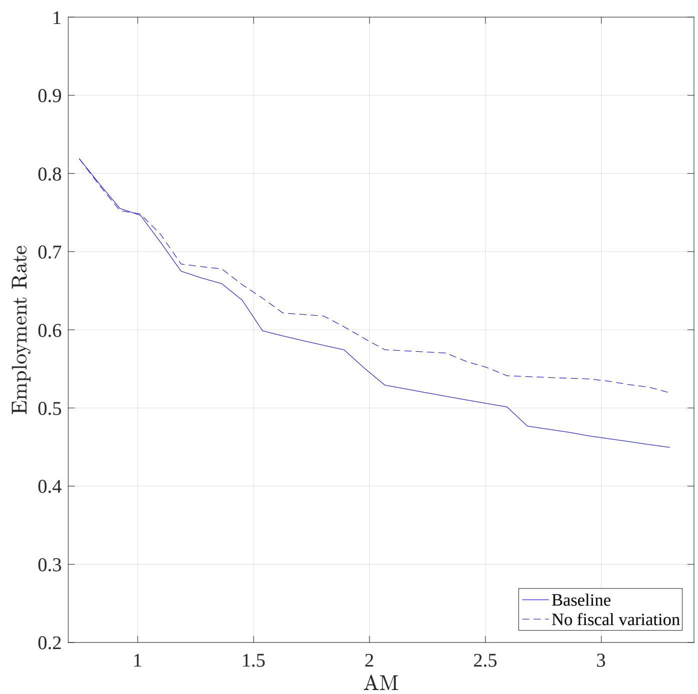
## 7. Conclusion

In this paper we ask why average hours worked are lower in rich countries than in poor countries, and why hours are negatively correlated with wages at the individual level within poor countries, but positively correlated within rich countries. To answer this question we build a model of individual and aggregate labor supply that features two main determinants of hours worked. The first is preferences with strong income effects, where individuals prefer to work fewer hours when their income rises. The second is tax-and-transfer systems, which dull incentives to supply labor, and which are much more prevalent in rich countries.

We find that to explain the negative correlation between average hours and GDP per capita, income effects in preferences are the driving factor. Tax-and-transfer systems play some role in the richest countries, but little role in explain why average hours per adult fall over most of the world income distribution. The simple intuition for this finding is that while income rises dramatically from the world's poorest countries to the world's richest, the expansion of tax-

Figure 11: The Role of Fiscal Polices for Labor Supply

(a) Employment Rate




(b) Sectoral Hours per Worker

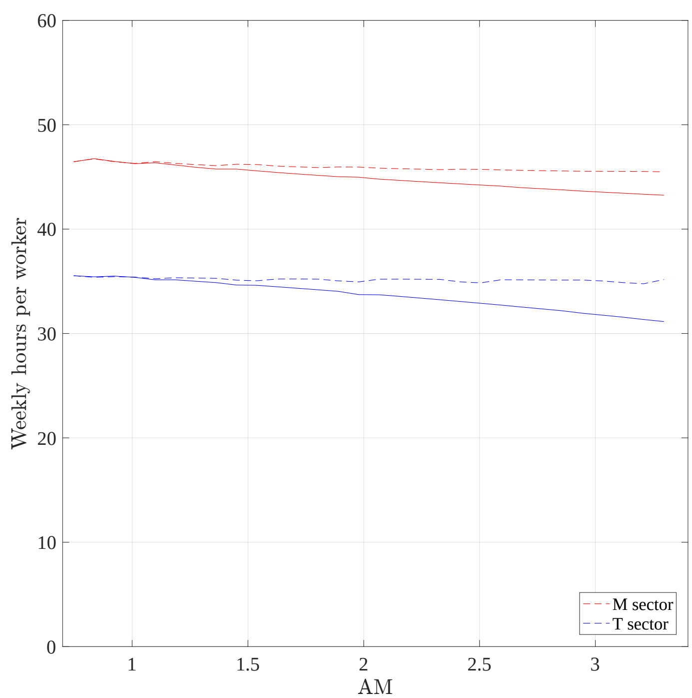
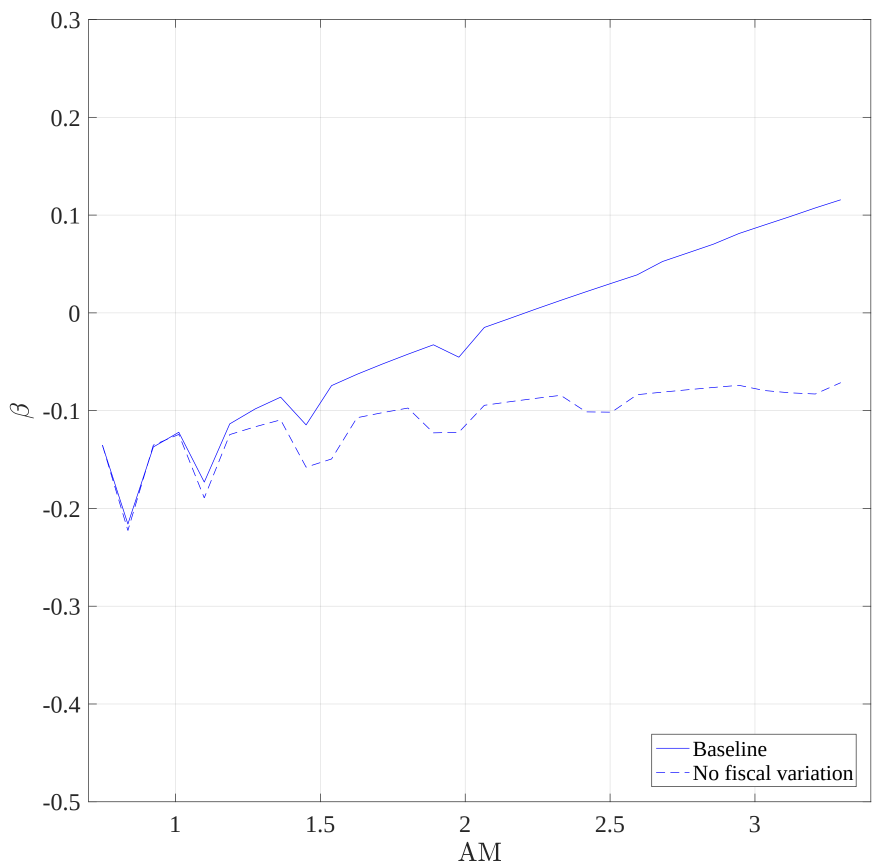


Figure 12: The Role of Fiscal Polices for the Hours-Wage Elasticity



and-transfer systems with development is much more modest, with average tax rates rising only slightly from the world's poorest countries to the middle of the world income distribution. One therefore requires strong income effects in preferences in match the substantial fall in hours over this income range.

On the other hand, both income effects and tax-and-transfer systems are crucial to explaining why individual hours-wage gradients are negatively sloped in poor countries and positively sloped in rich countries. Our specification of preferences features subsistence constraints, which reduce labor supply substantially as household income rises away from near the constraint. For low average levels of income, our preferences naturally deliver downward sloped individual hours-wage gradients. For higher and higher income levels, the hours-wage gradients flatten as households move further away from the subsistence constraints. Yet income effects alone cannot explain why gradients become *positively* sloped in the richest countries. Tax-and-transfer systems play a big role here, because they reduce labor supply of all workers but particularly those with the lowest wages, for whom transfers are largest relative to potential earnings. We conclude that both strong income effects in preferences and tax systems that expand with development are crucial ingredients for understanding the quantitative patterns of hours worked across countries. Models of aggregate labor supply that ignore one of these two channels are likely to yield misleading inferences about the drivers of hours worked.

## References


Aguiar, M. and E. Hurst (2007). Measuring Trends in Leisure: The Allocation of Time Over Five Decades. *Quarterly Journal of Economics 122*(3), 969–1006.

Bandiera, O., R. Burgess, N. Das, S. Gulesci, I. Rasul, and M. Sulaiman (2017). Labor Markets and Poverty in Village Economies. *Quarterly Journal of Economics 132*(2), 811–870.

Banerjee, A., E. Duflo, N. Goldberg, D. Karlan, R. Osei, W. Parienté, J. Shapiro, B. Thuysbaert, and C. Udry (2015). A Multifaceted Program Causes Lasting Progress for the Very Poor: Evidence from Six Countries. *Science 348*(6236), 772–788.

Besley, T. and T. Persson (2014). Why do developing countries tax so little? *Journal of Economic Perspectives 28*(4), 99–120.

Bick, A. and N. Fuchs-Schündeln (2017a, May). Quantifying the Disincentive Effects of Joint Taxation on Married Women's Labor Supply. *American Economic Review Papers & Proceedings 107*(5), 100–104.

Bick, A. and N. Fuchs-Schündeln (2017b). Taxation and Labor Supply of Married Couples Across Countries: A Macroeconomic Analysis. *Review of Economic Studies* (forthcoming).

Bick, A., N. Fuchs-Schündeln, and D. Lagakos (2018). How Do Hours Worked Vary with Income? Cross-Country Evidence and Implications. *American Economic Review 108*(1), 170–199.

Boppart, T. and P. Krusell (2018). Labor Supply in the Past, Present, and Future: A Balanced-Growth Perspective. *Journal of Political Economy* (forthcoming).

Constantinides, G. M. (1982). Intertermporal Asset Pricing with Heterogeneous Consumers and without Demand Aggregation. *Journal of Business 55*, 253–267.

Costa, D. L. (2000). The Wage and the Length of the Work Day: From the 1890s to 1991. *Journal of Labor Economics 18*(1), 156–181.

Fafchamps, M. and S. Lund (2003). Risk Sharing Networks in Rural Philippines. *Journal of Development Economics 71*, 261–287.

Feng, Y., D. Lagakos, and J. E. Rauch (2018). Unemployment and Development. Working Paper.

Flodén, M. and J. Lindé (2001). Idiosyncratic Risk in the United States and Sweden: Is there a Role for Government Insurance? *Review of Economic Dynamics 4*, 406–437.

Gollin, D. (2002). Getting Income Shares Right. *Journal of Political Economy 110*(2), 458–474.

Heathcote, J., K. Storesletten, and G. Violante (2014). Consumption and Labor Supply with Partial Insurance: An Analytical Framework. *American Economic Review 104*(7), 2075–2126.

Imrohoroglu, A. and M. Üngör (2016). Total Factor Productivity Levels: Some Anomalies in Penn World Tables. Working paper.

Jayachandran, S. (2006). Selling Labor Low: Wage Responses to Productivity Shocks in Developing Countries. *Journal of Political Economy 114*(3), 538–575.

Jensen, A. (2019). Employment structure and the rise of the modern tax system. Unpublished Working Paper, Harvard University.

Karlan, D., R. Osei, I. Osei-Akoto, and C. Udry (2014). Agricultural Decisions After Relaxing Credit and Risk Constraints. *Quarterly Journal of Economics 129*(2), 597–652.

Keynes, J. (1930). *Economic Possibilities for our Grandchildren*. New York: W. W. Norton. Reprinted in Essays in Persuasion.

McDaniel, C. (2011). Forces Shaping Hours Worked in the OECD, 1960-2004. *American Economic Journal: Macroeconomics 3*, 27–52.

Ohanian, L., A. Raffo, and R. Rogerson (2008). Long-Term Changes in Labor Supply and Taxes: Evidence from OECD Countries, 1956-2004. *Journal of Monetary Economics 55*(8), 1353–1362.

Ohanian, L. E. (2008). Back to the Future with Keynes. *Federal Reserve Bank of Minneapolis Quarterly Review 32*(1), 10–16.

Porzio, T. and G. Santangelo (2017). Human Capital and Structural Change. Working Paper.

Prescott, E. C. (2004). Why Do Americans Work So Much More Than Europeans? *Federal Reserve Bank of Minneapolis Quarterly Review 28*, 2–13.

Ramey, V. A. and N. Francis (2009). A Century of Work and Leisure. *American Economic Journal: Macroeconomics 1*(2), 189–224.

Restuccia, D. and G. Vandenbroucke (2013). A Century of Human Capital and Hours. *Economic Inquiry 51*(3), 1849–1866.

Rogerson, R. (2006). Understanding Differences in Hours Worked. *Review of Economic Dynamics 9*, 365–409.

Rogerson, R. (2008). Structural Transformation and the Deterioration of European Labor Market Outcomes. *Journal of Political Economy 116*, 235–259.

Storesletten, K., H. Tan, B. Zhao, and F. Zilibotti (2017). Fluctuating Like China: Structural Change and Labor Reallocation in a Lewis Economy. Technical report, unpublished manuscript.

Townsend, R. M. (1994). Risk and Insurance in Village India. *Econometrica 62*(3), 539–591.