Discussion paper

Should the marginal tax rate be negative?
Ragnar Frisch on the socially optimal amount of work

BY
Agnar Sandmo

This series consists of papers with limited circulation, intended to stimulate discussion

Should the marginal tax rate be negative?

Ragnar Frisch on the socially optimal amount of work

Agnar Sandmo[1]

Norwegian School of Economics (NHH)

January, 2017

Abstract

In the late 1940s, Ragnar Frisch published two articles in Norwegian that constitute a pioneering attempt to apply welfare economics to a problem of economic policy. The main contention of the articles is that there exists a fundamental externality in the labour market because the marginal productivity of labour depends both on input in the individual unit and on total labour use in the economy. While inspired by the problems of post-war reconstruction, Frisch came to regard it as a general problem in a decentralized economy, and he explores its consequences for wage and tax policy. While Frisch attached great importance to the analysis, it has received little attention in the subsequent literature.

1

Introduction

Ragnar Frisch has many claims to fame in the history of economic thought, including his work on econometric theory, macroeconomic dynamics and consumer theory. But he was a wide-ranging economist with a keen interest in economic policy, and some of his work on policy-related subjects has tended to be overshadowed by his more famous theoretical contributions[2]. A case in point is his analysis of what he referred to as the socially optimal amount of labour. Evidently inspired by his reflections on the challenges raised by economic reconstruction after the Second World War, it also drew on his interest in the application of economic theory to problems of policy design. His writings on this issue in the late 1940s are not easily accessible to the modern reader but clearly deserve the attention of the historian of economic thought. The purpose of the present paper is on the one hand to make his work on this topic – which was mainly published in Norwegian – known to a wider audience, and on the other hand to make a critical evaluation of it and establish some connections with related literature by other writers.

The question that Frisch posed was whether the labour market has an inherent tendency to generate too little labour effort. His first analytical formulation of the issue appeared in an article that he wrote for a journal published by the economics students at the University of Oslo (Frisch 1947). A year later he published another article (also written in Norwegian) in

---

[2] A pioneer of mathematical economics and econometrics, Ragnar Frisch (1895-1973) was one of the founders of the Econometric Society and the first editor of *Econometrica.* Most of his academic career was spent at the University of Oslo, while he also stayed for extensive periods of time abroad. He received the first Nobel Memorial Prize in Economics in 1969 (jointly with Jan Tinbergen). Strøm (ed., 1998) contains articles on various aspects of his life and work. The article by Andvig and Thonstad (1998) provides a short biographical treatment, Chipman (1998) surveys his central contributions to economic theory and econometrics, while Malinvaud (1998) presents a critical view of Frisch as a policy analyst, particularly in the development context. A more recent survey that emphasizes Frisch's methodological views is Bjerkholt and Dupont (2010).

the Swedish journal *Ekonomisk Tidskrift* which contains essentially the same analysis although in a more popular and discursive style (Frisch 1948).

An explanation of the nature of the two journals may be in order. The student journal *Stimulator* advertised itself as being published jointly by the Department of Economics (Socialøkonomisk Institutt) at the University of Oslo and by the association of the economics students; however, the board of editors was composed exclusively of students. Although it was mainly written by students, it also regularly contained contributions from their teachers; Frisch in particular published several articles in the journal. *Ekonomisk Tidskrift* was in 1948 in its fiftieth year of publication and could look back on a distinguished history with all the most important Swedish economists among its contributors.[3] It may seem curious that Frisch reserved his most analytic contribution for the student review while writing in a more popular style for an academic journal. As regards the article in *Stimulator*, it should be kept in mind that the Economics Department at the University of Oslo at that time was a world leader in terms of the training that students received in the use of mathematical and statistical methods, so that the style that Frisch adopted probably reflected his perception (which may or may not have been correct) of the analytical qualifications of the readership. With respect to the article in *Ekonomisk Tidskrift*, the Frisch archive at the University of Oslo contains some correspondence between Frisch and the journal's editor, Erik Lundberg, that throws some light on the matter. The article was originally written with a view to publication in a daily newspaper, but newspapers both in Norway and Sweden apparently found it too demanding and turned it down. It then came to Lundberg's attention, who wrote to Frisch

---

[3] Among these were Wicksell, Cassel, Ohlin, Heckscher, Myrdal and Lindahl. In 1965 the journal began publication in English and changed its name to the *Swedish Journal of Economics*. In 1976 it broadened its base and became the present *Scandinavian Journal of Economics*.

3

with an offer to publish it. Frisch's immediate response was to say that he would find it embarrassing to publish such a popular paper in a scholarly journal, but when reassured by Lundberg that the journal also had many readers among businessmen and public officials he gave his consent, although he asked permission to revise some paragraphs that he found unsatisfactory. Perhaps it was during this revision that he inserted a number of footnotes where the analysis is treated mathematically.

Motivation

In the introductory paragraph of Frisch (1948) we find some of the motivation for the analysis. Frisch refers to

> "… the phenomenon that in the post-war years there seems almost everywhere to be shortage of labour relative to the tasks that one would like to take up. This phenomenon has developed to become one of the most central economic problems of our time. Without great labour effort there will be no reconstruction." (1948, p. 63; my translation).

Following this statement Frisch launches into a didactic discussion of the possible meanings of the term "shortage of labour". Three possible meanings are identified. First, he argues that the term might refer to a situation where employment is abnormally low relative to what one might expect given the size and composition of the population, labour legislation etc. The second interpretation of the term is simply that there is excess demand for labour: at the given levels of prices and wages the demand for labour is higher than the supply. In equilibrium, when the supply and demand for labour coincide, there will by this definition be no shortage of labour.

The third interpretation is what Frisch calls "under-optimal employment". This is defined as a situation where although the labour market may be in equilibrium so that there is full employment in the conventional sense, actual employment is less that what is required to maximize the social surplus. The maximum of social surplus is defined as a situation of the greatest possible sum of utility for all members of society taken as a whole. The concept of the social surplus raises questions about the possibility of interpersonal comparison of utility[4], but Frisch discards such questions by the following remark:

> "It is unnecessary here to raise the question of whether such comparisons are in principle possible. It is sufficient to note that practically everything that goes under the name of social policy and most of economic policy in general are implicitly based on the assumption that such comparisons of utility are meaningful." (Frisch 1948, p. 65.)

He goes on to argue that although elements of all three meanings of labour shortage are present in policy discussions, the third is the one that has received least attention. Nevertheless, it is this which in the final instance is decisive. In the current debates about reconstruction and labour shortage there is no doubt that what people have in mind, if only unconsciously, is something much more fundamental than the balance between supply and demand, which may imply either high or low employment. Rather, the underlying idea is that employment should be at the level where it corresponds to a maximum of social surplus, and this is not guaranteed to be the case by the balance between supply and demand.

---

[4] The possibility of such comparisons had been the subject of a long debate in economics which had recently been revived by Robbins (1932), but Frisch does not refer to any of this literature.

Having read the introductory paragraphs in the two articles, the reader may wonder what the main argument is that motivates the analysis and policy prescriptions: Is it the pressing problems of reconstruction in the immediate post-war period[5], or is it something more general and fundamental? In the former case, the validity of the analysis might be seen as one of acute importance for a particular phase of history but limited to that particular situation, while in the latter case it should be regarded as representing a set of problems of general relevance for a decentralized economy. While the emphasis on the needs of reconstruction is slightly different in the two articles[6], a reasonable interpretation is that it was observation and reflection on the contemporary situation in Norway and other countries that started Frisch off along this line of thinking, but that once he began to formalize the problem he concluded that it was of more general importance and relevance.

The concepts of internal and external productivity

The core of Frisch's argument is based on the distinction between internal and external productivity[7]. Internal productivity corresponds to the conventional notion of the marginal productivity of labour: at the individual level, it represents the increase in output following an increase in effort by a single worker, all other inputs being held constant. The external marginal productivity is the increase in output that follows from an increase in total effort,

---

[5] Several Norwegian cities were severely damaged both during the German invasion in 1940 and by allied air attacks during the occupation. The northern county of Finmark was burnt down as German forces retreated before the Red Army in 1944-45. An early estimate (which Frisch must have known) of the loss of real capital for the country as a whole amounted to 18.5 per cent of the capital stock in 1939.

[6] In his first article, Frisch (1947) proceeds directly to the theoretical model, while the reference to reconstruction only appears later. The second article is more explicit with regard to the contemporary economic situation, in so far as it lays strong emphasis on the problem of reconstruction in the introductory paragraph (Frisch 1948, p. 63).

[7] In his 1947 article Frisch refers to the two concepts as the direct and indirect productivity of labour, while the 1948 article uses the terms internal and external. (The Norwegian words are practically identical to the English terms.) I follow here the latter usage.

which is assumed to have a positive feedback effect on output by all individuals[8]. For the individual worker, the output that he produces thus depends firstly on his own effort or labour time but secondly also on the total labour time that is supplied by other workers. It is "deeply realistic", Frisch argues, to take both components of labour productivity into account, not least in the current period of reconstruction where it is an everyday observation that the result of labour effort in one sector of the economy depends on other sectors functioning smoothly and without friction. He notes that the underlying reason for this interdependence has to do with the division of labour and the fact that there exists many different goods and services. But in his analytical formulation he disregards this heterogeneity and extracts "what is of principal importance" by postulating the existence of a single commodity which is produced according to the production function

(1) $c = Z(x, N)$.

Here x is "the number of working hours per individual per year", while N is the aggregate input of labour time in society and the function Z is assumed to be increasing in both arguments. Since all workers are assumed to be identical, the connection between individual and total labour time is simply

(2) $N = nx$,

Where n is the number of workers[9].

---

[8] As Frisch notes, this assumption is related to Alfred Marshall's (1890; 1920) idea of external economies of scale. This connection is discussed in more detail below.

[9] Frisch notes that since the second argument of the production function is assumed to represent the labour of «the others», this should more accurately be written as N-x. But, as he also notes, in a large economy, the two measures become practically identical.

The concepts of internal and external productivity can now be defined mathematically[10] as

(3) $Z_x = \partial Z(x, N)/\partial x,$ (with N constant)

and

(4) $Z_N = \partial Z(x, N)/\partial N.$ (with x constant)

Frisch also defines total marginal productivity as

(5) $dZ/dx = Z_x + nZ_N.$

He does not explicitly discuss the economic interpretation of this concept, but it is clearly meant to capture his central idea that an increase in an individual's labour effort increases not only his own output but also has repercussions on the productivity of all other workers in the economy.

It is worth noting at this stage that there is a certain vagueness in regard to the unit to which the production function (1) is assumed to apply. In Frisch (1947) this is especially notable in that the reference seems sometimes to be to an individual worker and sometimes to a firm. The 1948 article, on the other hand, refers alternatively to a single firm and to a particular sector of industry. The fact that in his second paper he discarded the individual worker interpretation is understandable. That one worker's effort has a positive effect on the output of others in the same firm is presumably reflected in wage setting and work organization within the firm; in modern usage, this externality would be internalized in the firm. Still, there remains some vagueness regarding the kind of units to which the externality is assumed to apply, since Frisch refers both to firms and "sectors". It is perhaps reasonable to

---

[10] In order to make it more intuitive, I have made some changes to Frisch's notation, which in any case is somewhat different in the two articles.

interpret him as holding the view that the distinction between the concepts of internal and total productivity is relevant and important at different levels of aggregation. I will return to this point below.

The social optimum and the market failure

Since all workers are assumed to be identical, the condition for a maximum of the social surplus can be found by maximizing utility for the representative worker. The utility function (or utility surplus as Frisch calls it,) which because of the assumption of identical individuals also represents social welfare, depends positively on consumption[11] and negatively on labour effort and is assumed to be additive in form:

(6) $W = \Omega(c) - U(x).$

Consumption is equal to disposable income, which is earnings, wx, minus taxes, T. The social budget constraint then becomes, in per capita terms,

(7) $wx - T = Z(x, N).$

This way of writing the social budget constraint is based on the assumption that tax revenue is used to finance some expenditure which has no direct effect on the utility of individuals; this is obviously meant just as an analytical simplification. Substituting from (7) into (6) and taking account of (2), we can write social welfare as a function of x alone:

(8) $W = \Omega(Z(x,nx)) - U(x).$

---

[11] Frisch actually writes utility as depending on disposable income, but since there is no saving in the model this must be equal to consumption, so that it is natural to write the utility function in this more conventional manner.

9

Maximizing (8) with respect to x and assuming the appropriate convexity/concavity

conditions to be satisfied (Frisch discusses these in detail in terms of second-order

derivatives), we can write the first order condition as

(9) $\Omega'(c)(dZ/dx) = U'(x),$

Or, substituting from equation (5) and dividing by $\Omega'(c)$,

(10) $Z_x + nZ_N = U'(x)/\Omega'(c).$

Note that the marginal utility of work effort is negative and equal to $-U'(x)$. $U'(x)$, being

positive, has therefore a natural interpretation as the marginal utility of leisure. Condition

(10) then says that at the social optimum the total marginal productivity of labour should be

equal to the marginal rate of substitution between leisure and consumption. Frisch does not

actually use the concept of the marginal rate of substitution, since he does not divide

equation (9) by $\Omega'(c)$; instead he interprets the expression by comparing changes in utility

from the viewpoint of maximizing the single worker's "utility surplus". For Frisch, an

adherent of the concept of cardinal utility, this formulation no doubt came more naturally

than one that relied on the marginal rate of substitution.

The economic interpretation that Frisch gives of condition (10) is actually less than

transparent. He refers to it as an example of Gossen's Law, which is the condition that at the

consumer's optimum, the ratio between marginal utility and price should be the same for all

commodities. But does Frisch's condition really describe the individual worker's behavior?

He justified this by using the example of Robinson Crusoe (before the arrival of Friday) who

will carry his work effort to the point where "the marginal sacrifice of work becomes equal

to the marginal productivity of labour times the marginal utility of the product" (Frisch 1947,

p. 9). But as an example to illustrate the theory this is a paradoxical choice because in the

10

Crusoe case of a one-person economy there can be no distinction between internal and external productivity. A more logical interpretation of (9) or (10) is as a characterization of the social optimum, and the crucial question then becomes whether in a decentralized economy with many workers and employers, individual incentives are such as to lead to an equilibrium which is consistent with the social optimality condition.

Frisch's answer to this question is negative, but the manner in which he tries to establish it is – from a modern point of view – curiously roundabout and unclear. Referring to (10) as an equilibrium condition, he compares it with an alternative equilibrium in which one "takes account only of the direct marginal productivity Z_x." This equilibrium is characterized by the condition

$$(11) \qquad Z_x = U'(x)/\Omega'(c).$$

In Frisch (1947, p. 10) this equation is shown in a diagram where a downward sloping curve showing marginal productivity (multiplied by the marginal utility of consumption) intersects an upward sloping curve showing the marginal disutility of effort; the intersection of the two curves represents the equilibrium level of effort. Frisch also draws another curve representing total marginal productivity as defined by (5). This curve lies everywhere above that of the direct marginal productivity, and its intersection with the marginal disutility of labour curve shows the equilibrium as defined by (10). He points out that the first equilibrium gives rise to less employment "and consequently a social product which is less advantageous for all individuals" (Frisch 1947, p. 10). He then goes on to argue that most existing economic systems, both the "liberalistic" and (although to a less extent) the "regulatory", tend to lead to an equilibrium of the second kind through a determination of the wage rate that relates it solely to the internal marginal productivity of labour. It is this

11

under-employment that is the fundamental cause of the popular perception that there is an overall scarcity of labour; presumably, Frisch saw the root of this perception in an implicit comparison between the optimum and the actual labour market equilibrium.

The failure of individual workers and firms to take the external productivity into account is clearly an case of external economies in the sense of Marshall, although Frisch does not use this term. In order to bring the analysis more in line with the approach taken by modern writers on externalities, it is natural to consider the optimizing behavior of the individual agent in a competitive labour market[12]. The problem faced by the individual consumer/worker can be written as

(12)   *Max Ω(c) – U(x) subject to c = wx,*

where w is the competitive wage rate and the price of consumption is set equal to unity. This leads to the optimum condition for the individual worker:

(13)   *U'(x)/Ω'(c) = w.*

Thus, each of the identical workers sets his marginal rate of substitution between leisure and consumption equal to the wage rate.

If one wants to stay faithful to Frisch's thinking, the modelling of the production side is slightly less obvious. As noted above, Frisch sometimes sees the production function (1) as referring to the individual worker, while he has little explicit discussion of the role of the firm. Since the scale of the firm is left indeterminate, profit maximization must be thought of in terms of profit per worker, so that the firm maximizes

---

[12] In Frisch's 1947 article the reference to perfect competition is left somewhat vague, while in the 1948 paper it is explicit although the mathematical formulations are relegated to footnotes.

(14) $\pi = c - wx = Z(x, N) - wx$

with respect to x. The assumption that the firm takes total effort or employment as given is

simply a reflection of the competitive assumption. Each firm is so small relative to the

market as a whole that it neglects the connection between its own decision with respect to

labour input and total labour use in the economy. Profit maximization implies that labour

input will be pushed to the point where its internal marginal productivity is equal to the

wage rate, i.e.

(15) $Z_x = w.$

Combining (13) and (15), we see that the competitive equilibrium corresponds to the second

equilibrium identified by Frisch. This is represented by condition (11) and is characterized by

under-employment of labour relative to the social optimum. Frisch concludes on this point

by emphasizing that "the system has accordingly an inherent tendency to bring labour effort

to a halt at a *lower* level than that which gives the largest utility surplus for the members of

society. The system comes in other words in its essence to be inefficient, to 'work against

nature'." (Frisch 1948, pp. 68-69.)

As an aside, an interesting reminder of social conditions at the time of his writing is Frisch's

emphasis on the dependence of the utility of consumption on the availability of consumer

goods. The incentive effect of an increase in the net wage depends crucially, he argues, on

the range of goods available in consumer markets; the wider the range of goods that are

available for purchase, the stronger is the incentive effect of higher wages. For this reason,

even though at this time of reconstruction priority must be given to the buildup of the

capital stock, one may have to allow a certain volume of production and import of consumer

goods. But this volume "must be *kept under the strictest control,* based on careful

13

calculations of how labour supply reacts to different types of stimuli. Only in this way can one prevent that the nation as a whole wastes its resources." Production and import of consumer goods must be "kept at the lowest level compatible with generation of a large labour effort." (Frisch 1948, p. 75, italics in the original.)[13] Rationing of consumer goods was very important in the Norwegian economy for several years after the war (as was the case although to a varying degree in all European economies), and this policy was evidently one of which Frisch strongly approved.

Implications for economic policy

Given its assumptions, Frisch's analysis identifies a market failure; he repeatedly expresses his conviction that this failure is of "fundamental importance" for understanding how the economic system works and how to face the challenges that confront economic policy makers in the post-war world. The next step in the analysis is therefore to identify possible remedies, preferably such as allow freedom of choice for the individual as regards his own work and consumption[14] while simultaneously generating the largest possible utility surplus for the economy as a whole.

In his discussion of the factors affecting labour supply, Frisch does not rely on any formalized theory. He discusses first the role of the net wage rate, i.e. the real wage rate after adjustment for the marginal rate of tax, pointing out that an increase in the net wage rate has an ambiguous effect on labour supply. His analysis of the two effects that arise corresponds closely to the modern distinction between the income and substitution effects,

---

[13] The Norwegian word "frampressing" that I have translated as "generation" could alternatively and more literally have been rendered as "squeezing forth".
[14] Frisch (1948, p. 69) remarks that the simplest remedy – the one that requires least constructive thinking - is simply to command people to work more. But "few of us would be willing to accept this solution in peacetime."

14

although he does not use these terms. The "direct effect" (corresponding to the substitution effect) encourages work effort while the "indirect effect" (the income effect) tends to reduce it; the total effect depends on the elasticity of the marginal utility of income or consumption.[15] He concludes this part of his analysis by arguing that one cannot with any confidence rely on manipulation of the wage rate alone as a tool for stimulating labour supply. On the other hand, by combining wage and tax policy in a suitable manner there will be significant possibilities for steering labour effort towards the optimum amount.

In order to evaluate Frisch's policy proposal along these lines it is important to understand his idea about what he calls an effort neutral ("innsatsupåvirket") tax.[16] The effort neutral tax has the property that the total amount to be paid by an individual worker is independent of those components of his income that are closely related to the amount of effort. As examples of such components Frisch mentions manual work that is paid by the hour (presumably with free choice of hours of work) or as piecework, doctors' and dentists' fees etc. In order to establish a mechanism whereby labour effort can be induced to approach the optimum point these components should simply be tax free. But the other parts of personal income, those that are not directly related to effort, may be taxed according to a proportional or progressive – preferably a steeply progressive – schedule. An important part of his proposal is that the tax should not simply be related to actual income but also to the individual's *consumption potential* as well as his *earnings potential*; this is an example of

---

[15] Maximizing the utility function $\Omega(c)-U(x)$ subject to the budget constraint $c=wx$, it is a simple exercise in comparative statics to show that the wage effect $\partial x/\partial w$ can be written as the sum of a negative income effect and a positive substitution effect. However, given the additive form of the utility function the sign of the total effect can be shown to be determined by the elasticity of the marginal utility of consumption, $-\Omega''(c)c/\Omega'(c)$. The wage effect is positive if and only if the elasticity is less than one. The possibility of empirically measuring this elasticity was analyzed in some detail in Frisch (1932).

[16] The Norwegian word - literally «effort-unaffected» - is one of Frisch's own invention, and I have not seen it used elsewhere.

what in the literature is referred to as *presumptive income*. "The smaller the consumption potential and the greater the earnings potential, the larger the personal tax would be." (Frisch 1948, p. 73.) Frisch mentions a number of observable indicators that can be taken to represent consumption and earnings potential. The main indicator of consumption potential is family size, and in both articles Frisch emphasizes strongly the need to take this into account in designing an income tax that incorporates the concern for social justice.[17] Indicators of earnings potential include sex, age, education, profession and health. Depending on the relative magnitudes of these indicators, the tax could become positive or negative depending on the taxpayer's circumstances. This way of designing the tax schedule might seem administratively complicated, but Frisch was nevertheless optimistic:

> "By studying the distribution of the population according to the characteristics to be taken into account in the tax assessment, it should not be a difficult actuarial problem to clarify how the tax rates ought to be set for the revenue to reach a given amount." (Frisch 1948, p. 73.)

An unconventional aspect of Frisch's policy analysis is that he does not limit his analysis to the case where wage rates are determined in the market but envisages a regime where the government can actually set the wage rates administratively. By combining wage and tax policy, he argues, the government can overcome the challenge that increases in the net wage rate are not guaranteed to increase labour supply. The solution that he proposes is as follows.

---

[17] In view of this, the statement in the previous quote that the personal (presumptive) tax should be decreasing with respect to consumption potential may be difficult to understand. It is evidently Frisch's opinion that for any given income the tax should be higher, the smaller the size of the family. If so, consumption potential must be defined in such a way that a small consumption potential corresponds to a small family, which is a little odd, so it is possible that the formulation is due to a slip of the pen.

The government sets wage rates that are above the market level. This in itself is not guaranteed to increase labour supply because of the opposing substitution and income (or direct and indirect) effects. The increase in wages should therefore be combined with an increase of income taxes that are effort neutral and computed in such a way that they exactly neutralize the income (or indirect) effect on labour supply. With the neutralization of the income effect only the substitution effect of the higher wage rate remains, and this is certain to increase labour supply. The revenue from the tax increase is then used to cover the deficits that arise in the firms when they are forced to pay wages that are in excess of the internal marginal productivity of labour. By combining wage and tax increases along these lines, the government can "through a series of successive approximations" approach the optimum level of employment as characterized by equation (10).

How the government should go about the implementation of this solution in practice is a problem that Frisch does not discuss in any detail. He acknowledges that

> "in practice there will of course be difficulties with obtaining data that can *quantify* the relationships that one needs to know. But when one considers the progress achieved in recent years with respect to the construction of ordinary demand curves, curves for the elastic of the marginal utility of income etc., it should not be beyond the realm of the possible to establish at least rough estimates that will provide guidelines for practical policy." (Frisch 1947, pp. 14-15.)

In addition, one would have to face the problem of how to design a setup for the administration of wages, but Frisch does not discuss this issue, suggesting that he did not regard it as a problem of much significance. Without going into a detailed evaluation of Frisch's proposal, it is fair to say that it raises a sufficiently large number of problems that it

is interesting to look for other solutions to the labour market failure that Frisch claimed to have identified.

Updating Frisch: The corrective tax solution

In spite of the contributions of Marshall, Pigou and others to the theory of externalities and the analysis of policy remedies for the inefficiency that externalities create, the more formalized theory of economic policy in the face of externalities, building on general equilibrium foundations, had not yet become a standard element of the public economist's tool kit at the time when Frisch wrote.[18] For an evaluation of his contribution and his line of reasoning, it will be useful to set out how a modern economist would analyze this problem, given the assumptions on which Frisch's analysis is based.

As regards tax policy, Frisch's attention is almost totally focused on the income tax. Assume that there is a tax on income with the marginal rate of tax equal to T'. The worker will then equate his marginal rate of substitution to the marginal reward to effort, which is the wage rate net of tax. Therefore, in analogy with (13), the worker's optimum is characterized by the condition

(16) $U'(x)/\Omega'(c) = w(1 - T')$.

Substituting from this and the profit maximization condition (15) into the condition for the social optimum (10), we have that

(17) $w + nZ_N = w(1 - T')$.

Rearranging terms, this becomes

---

[18] The late 1940s and early '50s saw a number of important contributions to welfare economics; among these, Meade (1952) was a pioneering analysis of externalities. However, this development came too late to have had any influence on Frisch.

(18) $T' = -nZ_N/w.$

The social optimum is attained where the marginal tax rate on earnings is *negative* and equal to the marginal external effect of increased individual labour effort. In evaluating this result one has to recall that in the model all individuals are identical and that the result for the marginal rate of tax does not imply anything about the global properties of the tax, such as the properties of the *average* tax rate as income increases. The result can be regarded as an application of the Pigouvian analysis of externalities and corrective taxes (Pigou 1920). Most modern applications of this analysis focus on negative externalities which should be neutralized by taxes; however, we have here a case of a positive externality that has to be remedied by a subsidy, not a tax[19].

Although he has presented all the building blocks needed for this conclusion, Frisch does not carry his formal analysis so far as to arrive at this precise result. While he clearly perceives that this result is a logical outcome of his own analysis, he does not pursue the formal analysis but simply remarks that

> "[if] one could establish a tax system where the total amount that a worker pays in direct taxes were to *fall* as his effort increased, this would be certain to have a favourable effect on the supply of labour. But such a system lies presumably beyond the practically possible, at least at the present time." (Frisch 1948, p. 72.)

The reference to the present time seems to suggest that Frisch envisaged a future development that might make this suggestion practically feasible, but he does not elaborate

---

[19] Note that (18) can be given an interpretation in terms of public goods: Through its effects on individual productivities, aggregate labour effort has some of the properties of a public good, and (18) measures its value by the sum of individual benefits. This is in line with the classical analysis of public goods by Samuelson (1954) as extended to the case of public factors of production in Sandmo (1972).

on this rather intriguing statement. In Frisch (1947, p. 14n) he says that such a tax would imply so many "complications and difficulties" that it would not be a feasible alternative. What he does not say is that an income tax with a negative marginal rate might appear unacceptable from the point of view of distributive justice. However, it should be kept in mind that in his own proposal of assessing taxable income on the basis of indicators of consumption and earnings potential, there would arguably be no objection to having a negative instead of a zero marginal tax rate on effort-related income, since redistributive objectives would be taken into account by the progressive tax schedule on presumptive income.

The encouragement of labour *supply* via a negative marginal tax rate on income is not the only tax policy solution to the problem of market failure. An alternative – one, however, that Frisch does not consider - is to stimulate the *demand* for labour via a tax subsidy on wages. To illustrate this solution, assume that firms are faced with a net of subsidy wage rate equal to w(1-s), where s is the rate of subsidy, while workers are paid the gross wage w. Modifying the first order conditions (15) and (16), we have that

(15') $Z_x = w(1-s)$

and

(16') $U'(x)/\Omega'(c) = w.$

Proceeding as above, we obtain the optimal subsidy rate as

(19) $s = nZ_N/w.$

Apart from the algebraic sign change involved in switching from a tax to a subsidy, this is equivalent to the tax solution (18).

20

Although the tax and subsidy solutions are equivalent, they nevertheless appear rather different when one moves beyond the context of this highly aggregative model and considers policy implementation in an economy of heterogeneous workers. The subsidy solution escapes from some of the distributional and administrative complications of a negative marginal tax rate on income, but Frisch does not consider the alternative of stimulating the demand for labour instead of the supply. In his 1948 article he has some brief remarks on tax and subsidy policy with respect to industry:

> "It would have been interesting to consider the motivation of firms from a point of view analogous to that which has been adopted for workers above. In principle there are many points of similarity. But in the present context it would have taken us too far. One would then have had to discuss company taxation on a broad basis." (Frisch, 1948, p. 76.)

This argument is a bit surprising, since it is not clear why one would need to discuss company taxation in more detail than Frisch actually did for the case of personal income taxation. The wage subsidy approach would also have been of particular interest for linking Frisch's proposal directly to Marshall's recommendation of subsidies to industries characterized by external economies of scale, as will be discussed further below.

Like Frisch's own proposal, both the tax and subsidy solutions have the effect of pushing up wages; in fact, his wage-tax-subsidy proposal can be seen as equivalent to either of the two alternative solutions. It is equivalent to the negative marginal tax rate on income because it rewards work effort on the margin by an amount in excess of the internal marginal productivity of labour. And it is equivalent to the wage subsidy because it makes it possible for firms to pay wages that exceed the internal marginal productivity of labour. Moreover,

the equivalence goes further than to matters of principle. Because all three solutions aim to achieve the optimal allocation defined by condition (10), if optimally designed they will also be equivalent in quantitative terms. The negative marginal tax rate must be equal to the wage subsidy, and this again must equal the gap between the administratively determined wage rate and the internal marginal productivity of labour, which, according to Frisch's proposal, would have to be implemented through a subsidy to firms that would enable them to pay the high wages.

To a modern economist convinced by Frisch's insistence on a fundamental externality in the labour market, his proposed remedy might easily seem less convincing than the wage subsidy solution which avoids the obviously very difficult problem of direct regulation of wages. Why he chose this complicated policy solution is a difficult question to answer. Perhaps his general distrust of the market mechanism and his strong belief in planning and regulation both played a part in leading him to this position[20].

Tax design

Frisch's proposed wage-tax-policy proposal is an interesting illustration of the optimistic view of central planning and the skepticism to the market mechanism that were characteristic of the immediate post-war period. However, his belief that it might be attractive to a majority of politicians was probably naive at the time and would obviously have even less chance of success at the present age. But some of his thoughts on tax design are still of interest. In particular, to an economist whose thinking about taxation seeks

---

[20] An interesting discussion of Frisch's views on planning versus markets is contained in Malinvaud (1998). The "planning movement" to which Frisch belonged derived their skepticism of market allocation of resources in part from their experiences with the Great Depression, in part from what they perceived to be the successes of Soviet-type planning.

inspiration in welfare economics, Frisch's vision of an optimal – or almost optimal – personal tax system has much to recommend it. Taxing effort-related income at a zero rate would be a good thing from the viewpoint of efficiency even if one is unconvinced by Frisch's externality argument, while if one accepts the externality argument one should logically go for the negative marginal tax rate as the first best solution. Taxing the effort neutral part of income according to a progressive schedule that makes allowance for relevant personal characteristics is equivalent to a system of individualized lump sum taxes, a key component in the welfare theorist's vision of the theoretically ideal tax system.

But there are also some obvious problems with Frisch's proposal. A central difficulty lies in distinguishing between effort related and unrelated income; this is essential in view of the recommendation that effort related income should be tax-free. Where to draw the line between them is an issue that is very sensitive to the time perspective. Of the indicators of taxable capacity that Frisch mentions, age and sex are clearly exogenous parameters, whatever time perspective one adopts. Except in the very short run, however, education and profession are endogenous variables that are subject to individual choice and therefore in principle determined by the nature of the tax system, including its degree of progressivity. As an example, an academic who has reached the top of his profession may be on a high fixed salary and earn only a small amount extra from lectures, consulting etc. If one only defines the extra earnings as effort-related one neglects the effort that has gone into the achievement of the position that commands the high fixed salary. Although that effort now lies in the past, the tax system should also apply to the young academic on the rise in the system, and to him or her the high marginal tax rate will obviously act as a disincentive to effort that may influence both his education and choice of profession.

The suggestion to base the personal income tax on presumptive income might also run into some political economy problems. Would people be content to let their income tax liability be assessed on the basis of the tax authorities' estimate of their presumptive income? One can easily suspect that this would be a problem, especially in the cases where presumptive income exceeds what taxpayers perceive to be their actual income. Perhaps it was problems of this kind that Frisch had in mind when he wrote:

> "In order to make such a tax system acceptable to the public one must carry out an extensive information campaign where one presents the implications of the system and explains that it must be designed in this way in order for national output to provide the greatest possible utility surplus for the members of society." (Frisch 1948, p. 74.)

One might think that this would be no easy task, but Frisch apparently did not regard it as a major obstacle to the acceptability of his proposal. In his work on the principles of economic planning, he always drew a line between the two problems of selection and implementation, where selection referred to the determination of the optimum to be reached by the planning process and implementation to the design of an institutional and administrative framework for this purpose. As Malinvaud (1998) has pointed out, most of Frisch's work on economic planning was concerned with selection while problems of implementation were largely neglected. The same bias can be discerned in his work on the socially optimal employment.

Relations to the literature

Frisch's two articles make no references to the literature, although there is one exception: In his 1947 article he notes that the concept of external productivity bears some resemblance

24

to Alfred Marshall's concept of external economies in production but writes that "our reasoning goes further, and we will attempt to draw the far-reaching principal consequences of this formulation of the problem." (Frisch 1947, p. 6.) Given this claim on the part of his own formulation, it is clearly interesting to see how his analysis is related to that of Marshall.[21]

Marshall introduced the concepts of external and internal economies by the following definition:

> "We may divide the economies arising from an increase in the scale of production of any kind of goods, into two classes – firstly, those dependent on the general development of the industry; and, secondly, those dependent on the resources of the individual houses of business engaged in it, on their organization and the efficiency of their management." (Marshall 1890; 1920, p. 266.)

A little further on, we find a more analytical statement of the same idea:

> "An increase of labour and capital leads generally to improved organization, which increases the efficiency of the work of labour and capital." (Marshall 1890; 1920, p. 318.)

Marshall's formulation of the theory of external economies originated in his conviction that an increase in demand often led to a decrease in price. This is difficult to explain given the standard competitive assumptions, because for firm size to be determinate, the marginal

---

[21] In the 1930s and '40s Frisch lectured to his students in Oslo on microeconomic theory using Marshall's *Principles* as his basic text. His mimeographed notes show that the main part of the lectures was concerned with a mathematical reformulation of the main content of Book V of the Principles; some of this material was published in English as Frisch (1950). However, the notes do not cover the theory of external economies in any detail, and his later articles may perhaps be seen, at least in part, as an attempt to fill this gap.

cost curve, which is also the individual firm's supply curve, must be increasing. The assumption of external economies in production reconciled the theory with Marshall's empirical conviction. As output increases, the firm's marginal cost increases also. But as all firms in the industry increase their output, the increase in the size of the industry feeds back on costs with the result that marginal cost curves shift downwards. The individual firm, being small relative to the market as a whole, takes industry output as given and therefore neglects its own contribution to the lowering of marginal costs for all firms. It is at this point that the parallel with Frisch's analysis emerges: The individual firm has no incentive to take account of the contribution of its own employment of labour to total employment in the industry; neither has the individual worker any incentive to consider the difference that increases in his own effort make to aggregate effort and overall productivity. To remedy this market inefficiency, Marshall proposed a subsidy to industries characterized by external economies of scale combined with taxes levied on industries with external diseconomies of scale[22]. Marshall's analysis was further developed and formalized by Pigou (1920; 1932, Appendix III), who postulated a cost function $F_r(x_r, y)$, where firm r's cost depends both on its own output x_r and industry output y. This formulation is very similar to that of Frisch, and like Frisch Pigou distinguishes between two notions of marginal cost, depending on whether or not the external effect on firm productivity is taken into account. But Frisch does not seem to have been aware of Pigou's analysis

It is easy to see how Marshall's theoretical argument as well as his tax policy recommendations could have provided some of the inspiration for Frisch's analysis, although, as we have seen, Frisch emphasized the challenge of post-war reconstruction as

---

[22] However, he presented his recommendations with a number of qualifications related to the possibility of their actual political implementation. For a brief summary of these, see Sandmo (2011, p. 230).

the main impulse for his work. But a direct comparison between the two formulations is not easy. To some extent, this is due to Frisch's theory being formulated in mathematical terms while Marshall relies on a verbal argument. But perhaps a more fundamental difficulty lies in the fact – already alluded to above - that Frisch does not make it clear to what level of decision-making his analysis applies. In his first article he is explicit in stating that the production function (1) refers to an individual worker (Frisch 1947, p. 6), implying that the problem arises because the worker neglects the positive effects of his own labour on the productivity of others. But this formulation does not accord well with the standard analysis of competitive labour markets in which workers are faced with a given wage rate in the market; rather, it seems to suggest an economy of individual entrepreneurs or small farmers.[23] In the second article he shifts attention away from the individual worker to focus on the organization of production:

> "In most fields of economic life it is the fact that every single firm or every single industry will be able to provide a larger and more efficient contribution to the aggregate national product the larger and more efficient activity that is carried out in *other* firms and industries." (Frisch 1948, p. 66.)

Further on, having introduced the distinction between internal and external productivity, he refers to different "sectors of economic life" without making it clear whether these sectors are to be understood as firm or industries. Since employment decisions are not normally made at the industry level, many would no doubt have found the argument to be more convincing if Frisch had followed Marshall in focusing on the decisions of the single firm and

---

[23] A possible interpretation might also be that the externality refers to intra-firm effects, so that individual effort is affected by total effort in the firm. But this argument is unconvincing because such effects would presumably be internalized in the firm.

27

letting the external productivity effects apply to the industry of which the firm forms a part.

It is possible that the lack of a precise statement regarding the decision unit to which the analysis applies reflects Frisch's reluctance to let his argument be valid for only one particular economic system. As pointed out above, he claimed that the distinction between internal and external productivity had relevance both for "liberalistic" and "regulatory" organizational forms. With respect to the latter case, there was both before and after the Second World War considerable interest in corporative organization of the economy in which much of decision-making authority would be vested in industry or branch organizations, and Frisch's broad references to sectors and industries could well be interpreted to allude to this type of economic system.

A backward look at earlier contributions that might have influenced Frisch is clearly of interest, but the fact is that apart from Marshall, there is no indication that he drew his inspiration from any particular economist of the past. Looking forward, later contributions to the literature on external economies of scale seem to have been written without knowledge of Frisch's writings on the topic, which, given the manner of publication of his articles, is of course hardly surprising. Prominent among later writers on the topic is Chipman (1970) whose article incorporates external economies of scale in a model of general competitive equilibrium. In Chipman's model, as in Frisch's articles, labour is the only factor of production. From the point of view of the individual firm, there is proportionality between output and labour input, but the factor of proportionality depends positively on aggregate labour input in the industry. This is an assumption which is very similar to that of Frisch, and Chipman also emphasizes the difference between what he denotes the subjective and objective marginal productivity, which parallels Frisch's distinction between the internal and

total marginal productivity of labour.[24] Chipman refers to Marshall's recommendation of subsidies to industries characterized by external economies of scale but does not discuss the possibility of increasing employment through the design of the income tax. In general, it seems that the literature on external economies of scale has tended to be divorced from the issue that occupied Frisch in the 1940s: overcoming the problems raised by the alleged externalities in the labour market through rethinking the design of the personal income tax. In the field of public economics and optimal taxation the situation is similar; the issue that Frisch believed to be of "fundamental importance" has received little or no attention.

Frisch himself did some further work on the issue. This did not result in any journal publications but in several (partly overlapping) contributions to the series Memoranda from the Institute of Economics at the University of Oslo (a list of these as well as of Frisch's published books and articles can be found at the Institute's home page uio.no/econ). Of special interest is a paper that Frisch wrote for the United Nations Economic and Social Council, Sub-Commission on Employment and Economic Stability, (Frisch 1949). This repeats the arguments of the two published articles although without any mathematical modelling. In addition, it presents numerical calculations for a multisectoral model framework using Norwegian data. However, no attempt is made to estimate the magnitude of the gap between internal and total marginal productivity which lies at the heart of his analysis, and the forceful statement of the theoretical argument found in the two articles tends to get lost in the mass of variables and numerical data.

The Frisch Archive at the Institute of Economics also contains some written comments on Frisch's articles by other economists. The most interesting of these is a 10-page comment by

---

[24] Chipman's article also contains an extensive and very careful review of the more general literature on external economies of scale and competitive equilibrium.

29

Lawrence Klein who spent about a year during 1947-48 at the Institute.[25] Klein moves

beyond the one commodity framework of Frisch to study a model with an arbitrary number

of goods and factors, where each good is produced in a different plant. This is in line with

Frisch's statement that the problem ideally requires a disaggregated model, but Klein seems

somehow not to have realized that it is the distinction between internal and total

productivity that lies at the heart of Frisch's argument. In Klein's model the interaction

between firms or sectors can in its entirety be captured by an economy-wide input-output

table of the now conventional type, so that the model cannot really do justice to Frisch's

original idea. Although in itself of limited interest, the note reinforces the impression that

externality arguments were not very familiar to economists in the 1940s, and that Frisch's

contribution may have had difficulties in getting sufficient appreciation for its theoretical

originality.

In an undated note to Frisch attached to the copy of the comment in the Frisch Archive,

Klein expresses the hope that Frisch will read it and that it will be possible to have a

discussion of it in the near future. However, there is no record of such a discussion, and I

have not been able to find any trace of Klein's interest in this issue in his later work.

 Concluding remarks

Ragnar Frisch's articles on labour market externalities and tax reform are of interest to the

historian of economic thought for several reasons. From the point of view of economic

history, they provide an interesting glimpse of some of the policy issues that occupied

economists in the immediate post-war period. Especially notable in this connection is

---

[25] Klein was at this time in the beginning of his distinguished career as a macroeconometric model builder, and it was his interest in this topic that attracted him to the University of Oslo with the prospect of collaboration with Frisch and Trygve Haavelmo; see Bjerkholt (2014).

Frisch's emphasis on the importance of mobilizing resources, in particular labour resources, for post-war reconstruction, and his willingness to subordinate other aims of economic policy, such as the satisfaction of demand for consumer goods, to this goal.

From the point of view of the history of economic theory, his articles must count as an early attempt to formulate a model of externality induced market failure and point the way towards a corrective policy. On this specific point, Frisch is ahead of the most prominent discussions of welfare economics at the time. The treatments of Lange (1942), Lerner (1944) and Samuelson (1947) hardly paid any attention to externalities and the violations of the optimality conditions that they created; nor, accordingly, did they contain any discussion of how economic policy should be designed to overcome them[26]. In these respects, Frisch's contribution is a remarkable one, although his discussion also shows that the systematic application of welfare economics to policy issues still had some way to go.

Finally, from the perspective of public economics, his ideas for an income tax that would combine a minimum of labour market distortions with elements of redistribution, while perhaps unconvincing as guidelines for practical tax policy, are still of interest as a policy proposal designed to reconcile conflicting objectives in the design of the personal income tax. From an efficiency point of view, the marginal tax rate ought to be zero in order to eliminate distortion in the labour market, while from the point of view of egalitarian social policy one would like the tax system to be progressive. Frisch's proposal, by taxing presumptive income according to a progressive schedule in combination with tax exemption for effort-rated income, in theory manages to combine both these objectives. However,

---

[26] This state of affairs actually continued during the decade of the 1950s; see the discussions in Sandmo (2015) and Medema (2015).

31

there can be no doubt that he severely underestimated both the problems of practical

implementation of the proposal as well as its political appeal.

|

References

Andvig, Jens C. and Tore Thonstad (1998), "Ragnar Frisch at the University of Oslo." Chapter 1 of Strøm (ed., 1998).

Bjerkholt, Olav (2014), "Lawrence R. Klein 1920-2013: Notes on the early years." *Journal of Policy Modelling 36*, 767-784.

Bjerkholt, Olav and Ariane Dupont (2010), "Ragnar Frisch's conception of econometrics." *History of Political Economy 42*, 21-73.

Chipman, John S. (1970), "External economies of scale and competitive equilibrium." *Quarterly Journal of Economics 84*, 347-385.

Chipman, John S. (1998), "The contributions of Ragnar Frisch to economics and econometrics." Chapter 3 of Strøm (ed., 1998).

Frisch, Ragnar (1932), *New methods of measuring marginal utility*. Tübingen: J. C. B. Mohr (Paul Siebeck).

Frisch, Ragnar (1947), "Den samfunnsmessig optimale arbeidsinnsats (The socially optimal employment)." *Stimulator 1*, no. 7, 5-16.

Frisch, Ragnar (1948), "Den optimale arbeidsinnsats (The optimal employment)." *Ekonomisk Tidskrift 50*, 63-80.

Frisch, Ragnar (1949), "Price-wage-tax-subsidy policies as instruments in maintaining optimal employment." United Nations Economic and Social Council, Economic and Employment Commission, Sub-Commission on Employment and Economic Stability, 18 April 1949.

Frisch, Ragnar (1950), "Alfred Marshall's theory of value." *Quarterly Journal of Economics 64*, 495-524.

Lange, Oscar (1942), "The foundations of welfare economics." *Econometrica* 10, 215-228.

Lerner, Abba P. (1944), *The Economics of Control: Principles of Welfare Economics*. London: Macmillan.

Medema, Steven G. (2015), "'Exceptional and unimportant'? The rise, fall and rebirth of externalities in economic analysis." Unpublished.

Malinvaud, Edmond (1998), "How Frisch saw in the 1960s the contribution of economists to development planning." Chapter 18 of Strøm (ed., 1998).

Marshall, Alfred (1890), *Principles of Economics*. 8th Edition, 1920. London: Macmillan.

Meade, James E. (1952), "External economies and diseconomies in a competitive situation." *Economic Journal 62*, 54-67.

Pigou, Arthur C. (1920), *The Economics of Welfare.* 4th Edition, 1932. London: Macmillan.

Robbins, Lionel (1932), *An Essay on the Nature and Significance of Economic Science*. London: Macmillan.

Samuelson, Paul (1947) *Foundations of Economic Analysis*. Cambridge, Mass.: Harvard University Press.

Samuelson, Paul A. (1954), "The pure theory of public expenditure." *Review of Economics and Statistics 37*, 387-389.

Sandmo, Agnar (1972), "Optimality rules for the provision of collective factors of production." *Journal of Public Economics 1*, 149-157.

Sandmo, Agnar (2011), *Economics Evolving.* Princeton: Princeton University Press.

Sandmo, Agnar (2015), "The early history of environmental economics." *Review of Environmental Economics and Policy 9*, 43-63.

Strøm, Steinar (ed., 1998), *Econometrics and Economic Theory in the 20th Century. The Ragnar Frisch Centennial Symposium.* Cambridge: Cambridge University Press.

Issued in the series Discussion Papers 2016

2016

01/16 January, **Ingvild Almås and** Anders Kjelsrud**,** "Pro-poor price trends and inequality|the case of India".

02/16 January, Tuomas Pekkarinen, **Kjell G. Salvanes,** and Matti Sarvimäki, «The evolution of social mobility: Norway over the 20th century"

03/16 February, Sandra E. Black, Paul J. Devereux, and **Kjell G. Salvanes**, "Healthy(?), Wealthy, and Wise. Birth Order and Adult Health".

04/16 March, Hiroshi Aiura, "The effect of cross-border healthcare on quality, public health insurance, and income redistribution"

05/16 March**, Jan Tore Klovland**, "Shipping in dire straits: New evidence on trends and cycles in coal freights from Britain, 1919-1939"

06/16 April, Branko Bošković and **Linda Nøstbakken**, "The Cost of Endangered Species Protection: Evidence from Auctions for Natural Resources"

07/16 April, Cheti Nicoletti, **Kjell G. Salvanes**, and Emma Tominey, "The Family Peer Effect on Mothers' Labour Supply"

08/16 April, Hugh Gravelle and **Fred Schroyen**, "Optimal hospital payment rules under rationing by random waiting"

09/16 May, Branko Bošković and **Linda Nøstbakken** "Do land markets anticipate regulatory change? Evidence from Canadian conservation policy"

10/16 May, **Ingvild Almås**, Eleonora Freddi, and **Øystein Thøgersen**, "Saving and Bequest in China: An Analysis of Intergenerational Exchange"

11/16 May, **Itziar Lazkano, Linda Nøstbakken**, and Martino Pelli, "From Fossil Fuels to Renewables: The Role of Electricity Storage"

12/16 June, Jari Ojala and **Stig Tenold**, «Maritime trade and merchant shipping: The shipping/trade-ratio from the 1870s until today"

13/16 September, **Elias Braunfels**, "Further Unbundling Institutions"

14/16 September, **Alexander W. Cappelen, Cornelius Cappelen, and Bertil Tungodden**», "Second-best fairness: false positives and false negatives in distributive choices"

15/16 October, **Aline Bütikofer**, Eirin Mølland, and **Kjell G. Salvanes**, "Childhood Nutrition and Labor Market Outcomes: Evidence from a School Breakfast Program"

16/16 October**, Itziar Lazkano** and Linh Pham, "Do Fossil-Fuel Taxes Promote Innovation in Renewable Electricity Generation?

17/16 October, Kristiina Huttunen, Jarle Møen, and **Kjell G. Salvanes**, «Job Loss and Regional Mobility».

18/16 November**, Ingvild Almås, Alexander Cappelen, Bertil Tungodden**, «Cutthroat capitalism versus cuddly socialism: Are Americans more meritocratic and efficiency-seeking than Scandinavians?"

19/16 December, **Gernot Doppelhofer, Ole-Petter Moe Hansen**, Melwyn Weeks, "Determinants of long-term economic growth redux: A Measurement Error Model Averaging (MEMA) approach "

20/16 December, Leroy Andersland and **Øivind A. Nilsen**, "Households' responses to price changes of formal childcare"

21/16 December, Wilko Letterie and **Øivind A. Nilsen**, "Price Changes - Stickiness and Internal Coordination in Multiproduct Firms"

22/16 December, **Øivind A. Nilsen** and Magne Vange, "Intermittent Price Changes in Production Plants: Empirical Evidence using Monthly Data"

2017

01/17 January, **Agnar Sandmo**, "Should the marginal tax rate be negative? Ragnar Frisch on the socially optimal amount of work"

Norges Handelshøyskole

Norwegian School of Economics

NHH
Helleveien 30
NO-5045 Bergen
Norway

Tlf/Tel: +47 55 95 90 00
Faks/Fax: +47 55 95 91 00
nhh.postmottak@nhh.no
www.nhh.no

Norges Handelshøyskole

Norwegian School of Economics

NHH
Helleveien 30
NO-5045 Bergen
Norway

Tlf/Tel: +47 55 95 90 00
Faks/Fax: +47 55 95 91 00
nhh.postmottak@nhh.no
www.nhh.no