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Discussion paper

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A Fundamental Externality in the Labour Market?

Ragnar Frisch on the socially optimal amount of work

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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 I am grateful to Olav Bjerkholt for his guidance in the use of the Frisch Archive at the University of Oslo. I appreciate the helpful comments of Vidar Christiansen, Steven Medema, Bo Sandelin and Eskil Wadensjö on an earlier version of the paper. Two referees and an associate editor provided constructive comments and criticism.

I. INTRODUCTION

Ragnar Frisch (1895-1973) has many claims to fame in the history of economic thought, including his work on econometric theory, macroeconomic dynamics and consumer theory, and his contributions to the theoretical developments in these areas have received the highest recognition and been widely discussed in the literature². 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. 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.

² A pioneer of mathematical economics and econometrics, Frisch 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. Together with Jan Tinbergen, he received the first Nobel Memorial Prize in Economics in 1969. Early surveys of his work include the articles by Arrow (1960) and Johansen (1969), while the volume edited by Strøm (1998) contains articles on various aspects of his life and work. Particularly notable among these is the article by Chipman (1998) which discusses his central contributions to economic theory and econometrics. A recent survey that emphasizes Frisch's methodological views is Bjerkholt and Dupont (2010).

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 and longer article (also written in Norwegian) in the Swedish journal *Ekonomisk Tidskrift* which contains essentially the same analysis although in a somewhat more popular and discursive style and with a more extensive discussion of the policy implications of the theoretical analysis (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 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. Therefore, the style that Frisch adopted probably reflected his perception (which may or may not have been correct) of the analytical qualifications of the

³ Among these were Knut Wicksell, Gustav Cassel, Bertil Ohlin, Eli Heckscher, Gunnar Myrdal and Erik 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*.

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, which throws some light on the matter. The article was originally written as a popularized version of the first article with a view to publication in a daily newspaper, but newspapers both in Norway and Sweden apparently found it too demanding and turned it down⁴. The manuscript then came to Lundberg's attention, who wrote to Frisch with an offer to publish it⁵. Frisch's immediate reaction was that he would find it embarrassing to publish such a popular paper in a scholarly journal, but since Lundberg reassured him that the journal also had many readers among industrialists and other practitioners, he gave his consent, although he asked permission to revise some paragraphs that he found unsatisfactory. Presumably it was during this revision that he inserted a number of footnotes where the analysis is treated mathematically, bringing it closer in style and analytical level to the first article.

Although there is considerable overlap between them, both the theoretical framework and the policy message becomes clearer when the two articles are read in conjunction. The first contains a rigorous presentation of the mathematical model on which the analysis builds, while the second article has a fuller discussion of the interpretation of the model and its policy implications. Taken together, the articles are interesting to the historian of thought for at least two reasons. The first is the insight that they offer into the thinking of a leading economist regarding the challenges of post-war reconstruction. The second and arguably the most important is the fact that the articles contain a pioneering effort to derive policy

⁴ From the introduction to the article it appears that it was written as a response to the encouragement of "Swedish friends" who found his thoughts on this question interesting.

⁵ Erik Lundberg (1907-1987) was a prominent member of the Stockholm School of macroeconomics and a leading figure in Swedish economic research. His international reputation was established with his *Studies in the Theory of Economic Expansion* (Lundberg 1937).

conclusions from an explicit analysis of externalities and market failure that was theoretically advanced for its time. Both these aspects of the articles will be discussed more fully below.

This is not the only occasion when Frisch's interest in a practical issue of policy led him to make original theoretical contributions. Another case in point is a chapter that he wrote in a book on nutrition issues that led him to an early formulation of the diet problem in linear programming; for a discussion of this see Sandmo (1993). An interesting common feature of the two contributions is that they show that Frisch, who often strived to make his models as general as possible, also mastered the art of constructing small models with a sharp focus on the specific problem that he set out to study, and in both articles Frisch strongly emphasized the need for abstraction and simplification. Thus, in the first of the articles he argued that the main task of theory is to extract the essential features from the myriad of elements that we observe in real life. The schemes of thought thereby established may sometimes appear unrealistic. However,

“The schemes seem ‘unrealistic’ only to those who have not been trained in the art of abstraction and who therefore do not manage to see ... that there are certain fundamental features of the solution that will remain unchanged even if all the ‘realistic’ features are added. These fundamental features will then emphasize just the point where the difficulty of the problem is located, or the point where one must begin to search if there is to be any hope of arriving at a practically useful solution.”

(Frisch 1947, p. 5.)⁶

In the following I first discuss Frisch's motivation for writing the articles, while the following sections present the crucial theoretical concepts and the model that leads up to his central

⁶ All translations from Norwegian are my own.

conclusions. I then outline the policy implications that Frisch drew from his analysis and go on to discuss the relations to the literature. In the concluding section I make a few remarks on Frisch's work in relation to developments in welfare economics and public finance.

II. 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.)

This is a rather striking statement, considering that it was written only a few years after the war. While many other economists, influenced by Keynesian ideas about aggregate demand (Keynes 1936) had expressed their concern about excess supply of labour and mass unemployment in the post-war period, Frisch worried about labour shortage.⁷ His view was evidently that full employment (in the conventional sense) would not be a major problem in the post-war period. However, even full employment in the conventional sense might fall short of the socially desirable level.

Following his introductory statement Frisch launches into a didactic discussion of the possible meaning of the term “shortage of labour”. Three possible interpretations are

⁷ At the time that Frisch wrote his papers, his Institute in Oslo enjoyed a visit from Lawrence Klein, who based on his econometric work at the Cowles Commission had gone against the majority view among American economists to predict almost no increase in unemployment, a prediction that proved to be largely correct.

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 according to 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 than 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 utility⁸, 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.

⁸ The possibility of such comparisons had been the subject of a long debate in economics, recently been revived by Robbins (1932), but Frisch does not refer to any of this literature. In his own work on the measurement of utility (Frisch 1932), the discussion of tax progressivity clearly implies the possibility of interpersonal comparisons of utility.

Nevertheless, it is this meaning of shortage that 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 likely to be the case even if the labour market is in equilibrium in the conventional sense.

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 period⁹ 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, 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. However, once he began to formalize the problem he became convinced that it was of more general importance and relevance.¹⁰

⁹ Several Norwegian cities were severely damaged both during the German invasion in 1940 and by allied air attacks during the occupation 1940-1945. The northern county of Finnmark was burnt down as German forces retreated before the Red Army in 1944-45. An early estimate (which Frisch clearly knew) of the loss of real capital for the country as a whole amounted to 18.5 per cent of the capital stock in 1939 (Aukrust and Bjerve 1945).

¹⁰ 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, strongly emphasizing the problem of reconstruction in the introductory paragraph (Frisch 1948, p. 63).

It is worth noting that there is hardly any mention of capital accumulation in the two articles, which may seem curious given the concern with reconstruction. One of the few exceptions is a brief passage in the first article (Frisch 1947, p. 15) where he argues that for practical application of his ideas the framework of analysis needs to be extended in various ways, and that the most important is to take account of capital accumulation, but he does not follow up this remark. Presumably, the explanation for this neglect was that he wished to focus specifically on the labour externality and that he did not want to be sidetracked by a broader discussion of the demands of reconstruction.

III. THE CONCEPTS OF INTERNAL AND EXTERNAL PRODUCTIVITY

The core of Frisch's argument is based on the distinction between internal and external productivity¹¹. Internal productivity corresponds to the standard 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, which is assumed to have a positive feedback effect on output by all individuals. As Frisch notes, this assumption is related to Alfred Marshall's idea (1890) of external economies of scale, but he maintains that

“Our reasoning goes further, and we will attempt to draw the wide-ranging principal implications of this formulation of the problem.” (Frisch 1947, p. 6.)

For the individual worker, the output that he produces 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

¹¹ 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.

“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

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

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

$$(2) \quad N = nx,$$

Where n is the number of workers¹².

The concepts of internal and external productivity can now be defined mathematically¹³ as

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

and

¹² 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 $N-x$. However, as he also notes, in a large economy the two measures become practically identical.

¹³ 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.

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

Frisch also defines total marginal productivity as

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

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 positive repercussions on the productivity of all other workers in the economy.

It is worth noting at this stage that there is a certain lack of clarity with 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 presumably gets reflected in wage setting and work organization within the firm; in modern usage, this externality would be internalized in the firm. There still 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 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.

IV. 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 single worker. The utility function (or utility surplus as Frisch calls it) depends positively on consumption¹⁴ and negatively on labour effort and is assumed to be additive in form:

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

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

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

This way of writing the social budget constraint is based on the assumption that tax revenue is used to finance some expenditure that 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:

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

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

$$(9) \quad \Omega'(c)(dZ/dx) - U'(x) = 0.$$

Or, substituting from equation (5) and rearranging terms,

$$(10) \quad U'(x) = [Z_x + nZ_N]\Omega'(c).$$

¹⁴ 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.

This is the condition for the social optimum. A modern economist would have preferred to divide through the equation by $\Omega'(c)$ and interpret it as equality between the marginal rates of substitution and transformation. But to Frisch, who preferred to work with a cardinal representation of utility, this interpretation would come less naturally.

Frisch elaborates on the condition in the following manner:

“If we have an isolated individual (e.g. a Robinson) who by his work effort can create a product which is of use to him, he will push his 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.)

He then points out that condition (10) represents a generalization of this line of reasoning where one takes account of both the internal and the external marginal productivity of labour, so that the relevant concept of labour productivity for the social optimum is its total marginal productivity. (Obviously, this generalization requires that one moves beyond the Robinson assumption to a many-person economy, since in the Robinson case there can be no externalities.)

The nature of the optimum is illustrated in Figure 1, which is directly reproduced from Frisch (1947). The vertical axis measures “grenseoffer og grensenytte” i.e. marginal sacrifice and marginal utility. On the horizontal axis one measures “arbeidstid”, i.e. working time. The upward-sloping curve $u(x)$ corresponds to $U'(x)$ in the present article and represents the marginal disutility or sacrifice of work. The fully drawn downward-sloping curve shows the right-hand side of equation (10), using somewhat different symbols. The intersection point A shows “optimal arbeidstid” or optimal working time. The dashed curve through point B represents the term $Z_x \Omega'(c)$, which is the right-hand side of (10) when no account is taken of

the external marginal productivity of labour. Point B accordingly shows “arbeidstid fiksert ved direkte grenseproduktivitet”, i.e. working time determined by direct [internal] marginal productivity.

[Figure 1 about here.]

Comparing the intersection points A and B, Frisch remarks:

“Any economic system – liberalistic or regulatory – which is such that it tends towards an equilibrium point where there is equality between the marginal sacrifice of labour for the worker and the product of his *internal* marginal productivity of labour and the marginal utility of income for him will therefore – when there exists an external marginal productivity – be an *inefficient system* in the sense that it leads to a *lower* labour effort than that which provides the largest utility gain to all members of society.” (Frisch 1947, p. 11.)

He then goes on to argue that most existing economic systems, both the “liberalistic” and (although to a less extent) the “regulatory”, tends to lead to an equilibrium of the kind represented by point B in Figure 1 through a determination of the wage rate that relates it solely to the internal marginal productivity of labour. This under-employment 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. In his second article, he formulates the conclusion slightly differently as follows:

“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.)

The failure of individual workers and firms to take the external productivity into account is clearly a case of external economies in the sense of Marshall, although Frisch does not use this term.

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 production of capital goods and 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 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.)¹⁵ 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.

V. IMPLICATIONS FOR ECONOMIC POLICY

¹⁵ The Norwegian word “frampressing” that I have translated as “generation” could alternatively and more literally have been rendered as “squeezing forth”.

Given its assumptions, Frisch's analysis identifies a market failure (although he does not use this term, which only became part of standard economics usage with the article by Bator (1958)). However, it should be kept in mind that he claimed that the failure was likely to occur under more general conditions, as shown in his repeated references to "regulatory" systems. In any case, 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 while simultaneously generating the largest possible utility surplus for the economy as a whole. Frisch (1948, p. 69) remarks that the simplest remedy – "the one that requires least constructive thinking" – is simply to command people to work more. However, "few of us would be willing to accept this solution in peacetime."

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, 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.¹⁶ He concludes this part of his analysis by arguing that one cannot with any

¹⁶ 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

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.¹⁷ 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 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

and a positive substitution effect. Moreover, 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, $-\Omega''(c)/\Omega'(c)$. 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).

¹⁷ The Norwegian word - literally «effort-unaffected» - is one of Frisch's own invention, and I have not seen it used elsewhere.

account in designing an income tax that incorporates the concern for social justice.¹⁸

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 himself 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.

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

¹⁸ The statement that the tax should be higher for a smaller consumption potential may be somewhat counterintuitive, but Frisch's intention is obviously to say that for a given income, the tax should be higher the smaller is family size. This interpretation requires that a small consumption potential is defined as implying a small family.

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 elasticity 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 an institutional 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.

VI. AN ALTERNATIVE TO THE WAGE-TAX-SUBSIDY SCHEME

At the time when Frisch wrote, the policy implications of externalities were mostly discussed in the Marshall-Pigou partial equilibrium framework and not based on explicit mathematical

models. The late 1940s and early '50s saw a number of important contributions to welfare economics with the article by Meade (1952) marking a new stage in the analysis of externalities, but this development came too late to have had any influence on Frisch.

However, the Pigouvian analysis of externalities and its implications in terms of corrective taxes and subsidies was well established at this time (Pigou 1920). Applied to the problem considered by Frisch, the market failure would be due to positive external effects and the policy recommendation would be a negative marginal tax on income from work. Although he presented all the building blocks needed for this conclusion, Frisch did not carry his formal analysis so far as to arrive at this precise result. While he clearly perceived that the result was the logical outcome of his own theory, 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 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. This might seem surprising, but in Frisch’s setup it would in fact not be a serious objection. The negative marginal tax rate would apply only to effort-related income while redistributive objectives would be taken

into account by the progressive tax schedule on presumptive income. When viewed in this perspective, it is not surprising that Frisch apparently saw the problems of a negative marginal tax rate mainly as relating to tax administration and not to distributive justice.

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. In terms of Fig. 1, such a policy would be equally capable of shifting the market equilibrium from point B to A. The subsidy solution escapes from some of the problems that might arise from 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.

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. This had been a prominent aspect of his work at least since the 1930s. Thus, in a long article in *Econometrica*, he had proposed an elaborate system for quantitative adjustment of supply and demand designed to circumvent what he saw as the fundamental weaknesses of the price mechanism (Frisch 1934). Although the policy concerns are quite different, there are also similarities between that contribution and his articles from the 1940s. His proposal for a national organization of a commodity and service exchange envisages an elaborate administrative setup that clearly would be enormously complicated and costly, and his suggestion for a wage-price-subsidy

scheme with administratively fixed wages would obviously run into the same difficulties, posing similar challenges for the system of economic planning.

VII. FURTHER PROBLEMS OF 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 widespread among economists in 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 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. For a middle-aged person earning a high income, her past choices of education and profession may be seen as exogenous and part of her personal characteristics. But at an earlier stage in life they were objects of choice, and a neutral tax system should obviously be designed so as to apply to all stages of the life-cycle.

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. However, he clearly is not the only economist whose work on economic policy has been biased in this direction!

VIII. RELATIONS TO THE LITERATURE

Frisch's two articles contain no references to the literature, although there is one exception:

As noted above, he points out that the concept of external productivity bears some resemblance to Alfred Marshall's concept of external economies in production and claims that his own work represents a further development of Marshall's ideas. Given this claim, it is interesting to study how his analysis is related to that of Marshall. Frisch was very familiar with Marshall's work. In the 1930s and '40s he lectured to his economics students in Oslo using the *Principles* as his basic text. His mimeographed lecture notes show that a substantial part of the lectures was concerned with a mathematical reformulation of the main contents of Book V of the *Principles*; some of this material was later published as Frisch (1950).

However, neither the notes nor the article pays much attention to the theory of external economies.

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 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. However, since the individual firm has no incentive to take account of the effect of its own output expansion on industry costs, the result will be an equilibrium of the industry that fails to exploit the potential economies of scale. 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 or the country as a whole; 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 scale¹⁹. 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 – except for being formulated in terms of output instead of labour - is very similar to that of Frisch, and like

¹⁹ 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 e.g. Sandmo (2011, p. 230).

Frisch Pigou distinguishes between two notions of marginal cost, depending on whether or not the external effect on firm productivity is taken into account. However, there is no indication that Frisch in his more specific analysis of labor market failure was aware of this discussion.

The tax implications of external economies of scale was also studied by R. F. Kahn who pointed out that

“if external economies of scale are at all appreciable over the field of industry in general, it is socially desirable to stimulate the supply of factors of production (Kahn 1935, p. 19.)

This is a more general formulation of Frisch’s more specific idea concerning the need to stimulate labour supply, but again there is no indication that Frisch was aware of this contribution.

Going back to Marshall, it is easy to see how his theoretical argument as well as his tax policy recommendations could have provided some of the inspiration for Frisch’s analysis.

Nevertheless, 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. However, 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, implying that the problem arises because the worker neglects the positive effects of his own labour on the productivity of others:

“We shall assume that the single individual’s labour productivity has both a direct and an indirect component in the following sense: The output created by the

individual worker depends firstly on the labour time supplied by the individual, but secondly also by the total labour time achieved in society.” (Frisch 1947, p. 6)

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.)

This is very close to Marshall’s formulation of the problem. Later on, having introduced the distinction between internal and external productivity, Frisch 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 more convincing if Frisch had followed Marshall in focusing on the decisions of the single firm and 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 where labour is the only factor of production and where the firm's output depends both on its own labour input and on total industry input. 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. Chipman refers to Marshall's recommendation of subsidies to industries characterized by external economies of scale and also refers briefly to the possibility of correcting the externality through a measure designed to increase factor supply.²⁰ In general, however, the literature on external economies of scale has come to neglect the specific "under-employment" issue that occupied Frisch in the 1940s. In the field of public economics and optimal taxation the situation is similar; the problem 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

²⁰ Interestingly, he does not consider the design of the income tax in this connection but refers to the argument that advertising may serve a social purpose in encouraging people to work more so as to be able to reap the benefits of mass production (Chipman 1970, p. 373.)

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).²¹ 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 that 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 type-written comment by Lawrence Klein who spent about a year during 1947-48 at the Institute.²² 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. However, although Klein in the first paragraph of his comment states clearly the novelty in Frisch's formulation of the production function, in his own modelling this feature gets lost and the distinction between external and internal productivity, so central to Frisch's theory, disappears from sight. In Klein's model, the interaction between firms or sectors can in its

²¹ In Frisch (1948), he refers to such a memorandum as having been presented to the Sub-Commission some time in 1947, so it must have had some kind of circulation before the publication of the 1949 version.

²² Klein was at this time in the beginning of his distinguished career as a macroeconomic 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). However, before embarking on this career, that gained him the Nobel Memorial Prize in 1980, he was known chiefly for his development of Keynesian ideas. His book *The Keynesian Revolution* (1947) was especially influential.

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 therefore 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.

IX. 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 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 them²³. 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. It has long been part of the conventional wisdom that from the point of view of efficiency the marginal tax rate ought to be zero in order to achieve optimal utilization of labour. With Frisch's externality assumption, the conclusion must be modified to recommend a negative marginal tax rate, although Frisch was somewhat reluctant to draw this conclusion. Whether the marginal tax rate is zero or negative, many would regard the conclusion as unattractive from a distributional point of view. Frisch's proposal overcomes this objection by taxing presumptive income according to a progressive schedule, in combination with tax exemption for effort-related income. As a vision of an ideal tax system, this has much to recommend it. However, there can be no doubt that Frisch severely underestimated both the problems of practical implementation of the proposal as well as its political appeal.

²³ This state of affairs actually continued during the decade of the 1950s; see the discussions in Sandmo (2015) and Medema (2015).

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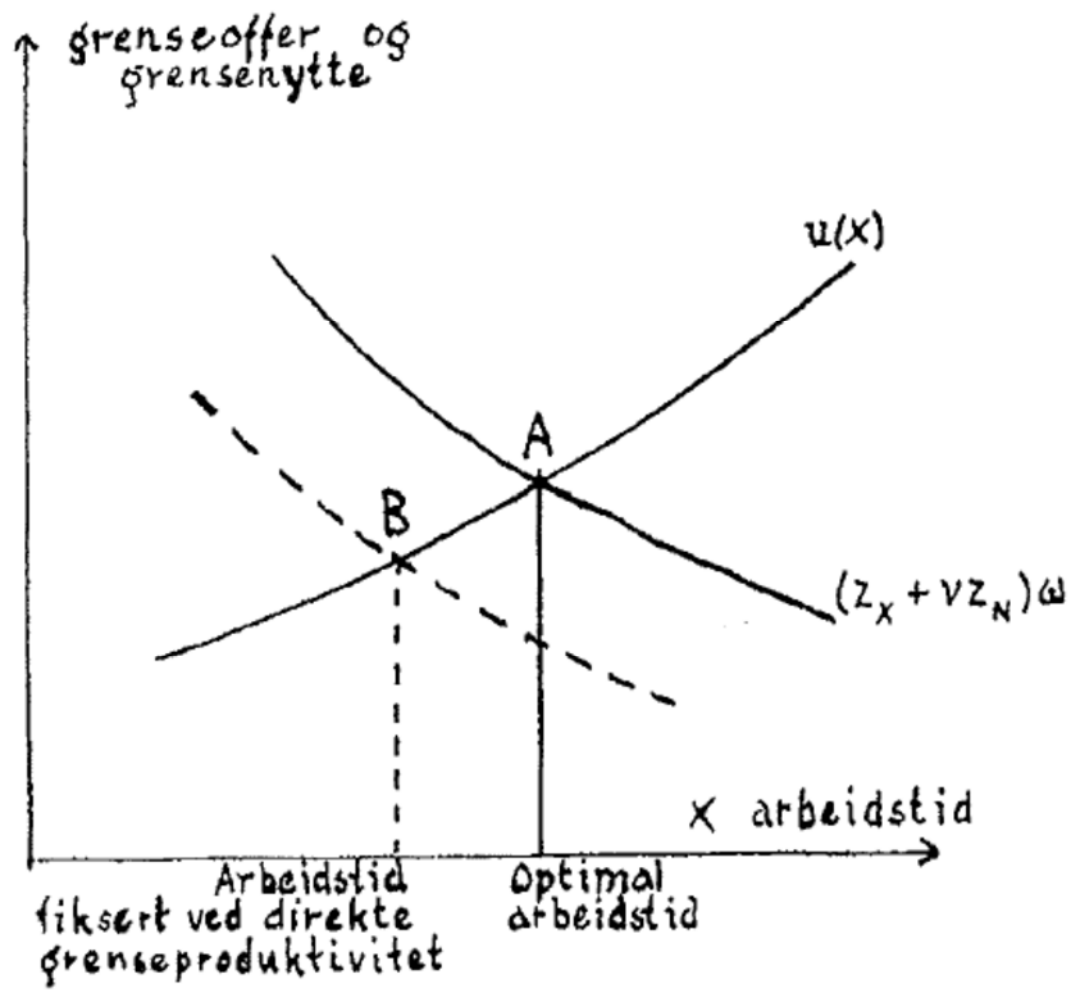


Figure 1.

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