“Effect of monetary policy on productivity in Canada.”

Introduction

It is now increasingly established that Central Banks exercise control over nominal and real magnitudes, in regimes where banks desire to hold zero reserves, not by altering the stock of reserves nor by fixing interest rates but rather by operating upon the spreads or the relative price of banking services. Central Banks always affect the price of banking services which are essentially the supply of liquid, and accessible-at-least-cost, intertemporal transactions services. Central Banks are always operating upon this real relative price so that the set of all relative prices cannot be ascertained independently of the activity of the monetary authorities. Just as Keynes argued we now must work with a monetary theory of value.

Current Monetary Policy

Modern Central Banks, such as the Bank of Canada and the Reserve Bank of Australia, have learned that by ‘setting spreads’, i.e. by charging higher than market interest rates on banks’ negative settlement balances held with them and paying lower than market rates on banks’ positive settlement balances, they constrain banks to pursue overdraft and deposit policies such that the banks may expect to be in zero settlement balances position in their clearings with the Central Bank (hereafter just the Bank), unless the Bank is taking non-neutral action. Unless the Bank non-neutrally takes what I call enforcement actions, such as open market operations or ‘repos’ or redeposit and drawdown of government deposits (or overdrafts) with the banks, the banking system, i.e. the set of all financial intermediaries offering transactions services, will always be in balance, in an overall zero settlement balance position with the Bank. Set aside circulating currency for the appendix. In a world of paper transactions or increasingly electronic debits and credits, one individual’s debit (an increase in her

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1 A draft of a presented to Statistics Canada Economic Conference ‘99 Probing the New Economic Realities, 23-24 March 1999. I draw upon previous papers but in particular on those presented at the 1997 meetings of the CEA, to the 1998 meeting of the International Association for Research in Income and Wealth in Cambridge, to the University of Manitoba Delta Marsh Seminar in October 1998 and to the Workshop on measuring bank output at Brookings in November 1998. Without implicating them in any way for all my errors, I would like to thank for all their help and comments Colin Rogers, Steve Ferris, Jack Galbraith, Jack Triplett, Steven Keuning, Anthony Waterman and others at the various conferences. In particular, I would like to thank Kevin Clinton of the Bank of Canada for his critical but constructive remarks on my work.

overdraft or decrease in her deposit) must be matched by another individual’s credit (an increase in his deposit or decrease in his overdraft). If the individuals transact through different banks, her bank will be experiencing a negative settlement balance with the Bank while his bank will be recording an equivalent positive settlement balance. A market in settlement balances will exist, such that through their private clearing arrangements, a House, her bank will borrow his bank’s positive clearing balance at a rate lower than the Bank would charge while his bank would loan its positive settlement balance at a rate higher than could earned with the Bank. Hence, unless the Bank puts the banking system as a whole into a non-zero settlement balance position, the interbank market (or House) in settlement balances will clear at spreads or 'service prices' below those of the Bank.

Central banks no longer need to conduct policy by operating on the reserve base of the banks through open market operations nor need they operate through some Bank rate mechanism.³

Private non bank agents transact with banks and face interest rates in overdrafts which exceed rates paid by the banks on deposits, the spread said to be the 'price' of banking services. Of course, the 'spread' the banks charge their customers is, in general, greater than that charged by the banks*House and the 'spread' charged by the Bank.

From Baltensberger⁴, the liquidity costs of a competitive bank are given as

\[ L \geq R \% \int \frac{\text{?}(X\&R)f(X)dX}{m} \]

where \( i \) is the opportunity cost of reserves, \( R \) is precautionary reserves, \( ? \) is the penalty rate charged (say) by the Bank for being in reserve deficiency, \( X \) is the net loss experience, \( f(X) \) the density function of such withdrawals assumed normal so that \( E(X) = f \). The liquidity costs are minimized when

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³ For a statement that the central banks still however operate on interest rates, indeed, a neutral real interest rate, see Alan Blinder, CENTRAL BANKING IN THEORY AND PRACTICE (Cambridge, MIT Press, 1999) For reiteration of the standard view “...that monetary policy cannot affect real interest rates in the long run...”, see Charles Freedman and Tiff Macklem, “A comment on ‘The great Canadian slump’”, Canadian Journal of Economics, XXXI, August 1998, 651.

so that if \( R \) is zero, \( \phi \left( \frac{X}{dX} \right)^m \), or what emerges is the '2 for 1' rule currently imposed by the Bank of Canada on paper clearings.\(^5\) That is, in order for a bank to conduct its overdraft and deposit policies such that it expects to be in a zero settlement balance position in the clearings, the penalty rate must be twice the opportunity cost rate, for example, the rate banks could earn on demand overdrafts.

The structure of interest rates implied by the Baltensberger '2 for 1' rule is that if the Bank would pay a zero rate on positive settlement balances, \( i_{cr} = 0 \), this implies that the cost of holding a positive settlement balance with the Bank is \( i - i_{cr} / d_{CB} \) and that the penalty rate, designated \( i_{dr} (=2i) \), implies that the cost of holding a negative settlement balances with the bank is \( i_{dr} - i / d_{CB} \). The expression \( d_{CB} \) is the carrying cost, spread or service charge the Bank is levying for the provision of atemporal and intertemporal clearing and liquidity services.\(^6\)

When the Bank raises \( i_{dr} \) without altering \( i_{cr} \), it raises the charge it makes for the provision of services to the banks. The service charge is composed of two parts: trivial debit and credit fees which 'price' the number of transactions; and the carrying cost, the 'price' for the provision of liquidity services to them. Similarly, the House charges its members fees for its final clearing, as the banks swap settlement balances and for the monitoring costs involved in the provision of the liquidity services the House provides its members.

Individuals use the transactions services of banks since they (i) delegate the monitoring of persons to whom they would lend and from whom they would borrow to the banks because it is less costly for the banks, specializing in this activity, to do so; (ii) they use overdrafts and deposits for the execution of transactions (and may use private bank notes as well) because, unlike other financial

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\(^6\) For a discussion of Keynes’s refutation of such rules, see my “Keynes and anchorless banking”, Journal of the History of Economic Thought, XX, Number 1, 1998, 71-82.
intermediaries, banks promise to keep unchanged the nominal value of such overdrafts and deposits⁷ and (iii) subject to known costs (the debit and credit fees and carrying costs) they debit and credit their deposits and overdrafts because of immediacy of access on the part of depositors and non-immediacy of call experienced by overdrafters.⁸ Banks provide monitoring, a common service of financial intermediaries, but their assets and liabilities used in transactions are fixed in nominal terms with clear terms of accessibility and established interest rates, debit-credit fees and carrying costs.

A bank is able to offer immediacy of access to demand depositors and non-callability to overdrafters because it can tap the provisions of liquidity by the House. A bank will not necessarily demand payment of an overdue overdraft if it thinks the overdrafter’s credit is good but is merely in an illiquid position if it can in turn borrow, at a cost in the House, in turn not subject to immediacy of call. Thus, the bank’s overdrafters and depositors are using indirectly the immediacy of accessibility at-least-cost services supplied by the House. Ultimately, of course, the banks and their House fall back on the services of liquidity, provided at cost, by the Bank.

Banks, though increasingly less so, charge for their services through ’spreads*. A simple revenue statement for a bank, with respect to overdrafts and deposits would be

\[ i_o O \& i_D D; \]

for a House

\[ i_B B \& i_L L; \]

and for the Bank

\[ i_{Dr} Dr \& i_{Cr} Cr \]

where O and D are vectors of the banks’ overdrafts and deposits, with their various rates, \( i_o \) and \( i_D \); B and L are the borrowings from and lendings to the House by its members, with their rates \( i_B \) and \( i_L \); and \( D_r \) and \( C_r \) are the negative and positive settlement balances of banks with the central Bank, not swapped in the House, with their respective rates \( i_{Dr} \) and \( i_{Cr} \).

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⁸ A demand deposit has immediacy of access, a time deposit has an option which inhibits immediacy of access (or makes it more costly), with a time overdraft a bank cannot call so the overdrafter is not subject to harassment while a demand overdraft is subject to call on demand.
One argues that \( i_o - i \) is the service charge levied on overdrafters and depositors by banks, \( i_o - i D \) is that levied by Houses on their members while \( i_D - i_C \) is the service charge levied by Banks on banks unable to obtain accommodation through the House, that is, the price charged for the ultimate liquidity provided by the Bank.

Suppose the 'spreads' are such that the House and banks are producing a volume of nominal overdrafts and deposits - that is, are producing a volume of services - with which the Bank is content. Suppose the banks begin an expansion of overdrafts and deposits with which the Bank is not in accord. There is no nominal stock of fiat money to constrain this Wicksell-Keynes expansion. Modern Banks would raise their spreads, i.e. they would raise \( i_D \) and lower \( i_C \). The Bank's spread is higher, and the House and clearing banks know the price of the liquidity services offered by the Bank is higher. To the House and clearing banks, the cost of straying from zero to negative settlement balances and with straying from zero to positive settlement balances has risen. Competitive banks (and their House) will therefore try to balance their portfolios away from overdrafts and deposits. Their spreads, their service charges, will rise. Non banks will find therefore intertemporal surplus and deficit positions more costly and planned investment and savings will contract.

The Bank has not reduced reserves (there are none to reduce) by either open market operations or drawdowns, nor has it raised interest rates per se. Rather it has raised its spread and the House and

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9 The UN (United Nations, SYSTEM OF NATIONAL ACCOUNTS 1993) argues there exists a 'pure*rate \( i \), such that \( i_o - i \) is the service charge paid by overdrafters and \( i - i_o \) is that service charge paid by depositors. As Kishori Lal argues, there is a vector of 'pure' rates, one for terms of deposits and overdrafts. See Kishori Lal, "Financial intermediation services indirectly measured (FISIM) and the Canadian System of National Accounts", in THE 1993 INTERNATIONAL SYSTEM OF NATIONAL ACCOUNTS: Collected articles of Kishori Lal (Ottawa: Statistics Canada, 1994)

10 In Canada, the Bank raises its borrowing and lending rates together, operating with 'bands'. The increases in its lending rate, the rate it charges for negative settlement balances, constrains banks to reduce their overdrafts. The increase in the borrowing rate, the rate the Bank pays on positive settlement balances, constrains banks to increase their deposits. Both represent an attempt by the banks to move their portfolios away from those generating negative balances and towards those generating positive settlement balances but, try as they may, unless the Bank accommodates them, they cannot do so. The term structure of rates on the vector of overdrafts and deposits rise to the levels the Bank desires. The general public will endeavour to reduce investment and increase savings, having the desired negative effect on aggregate demand.

11 If banks, the House and the central Bank reduced their spreads and substituted instead specific carrying costs (or service charges) on overdrafts and deposits on borrowing and lending and on negative and positive settlement balances, then it would be clear that the Bank exercises control by
the banks follow suit. The whole set of intertemporal transactions services banks provide has increased in relative price and the volume of bank output contracts. Since banking output is used by firms and households as inputs into final demand components and as intermediate inputs in production the decline in banking output is associated with a contraction in final demand and the net output of the whole economic system.

The Bank attempts to thwart the expansion in banking, and aggregate output, not by contracting the growth of some particular definition of money or high-powered money nor by raising interest rates. Rather it does it by raising the price of liquidity - the charge for the service the Bank ultimately provides. Since the demand for liquidity provided by the banks, the House and the Bank is continually changing in a Keynesian world of uncertainty, the Bank must always be operating with the relative price of banking services and output. Central Banks therefore have unrelenting real effects in the economy. Earlier views which had Banks changing some costless stock of fiat money can easily be shown, with model-consistent expectations, to ensure that Banks have no ‘real*effects. Such views are, however, no longer applicable. Similarly, those views which had central Banks setting interest rates and able somehow to affect not just nominal but real interest rates seem questionable. Blinder (op. cit.), fails to show how Banks can alter the real neutral interest rate, his instrument of monetary policy.

To recapitulate, I argue that no Central bank need operate on a base¹² nor on a Bank Rate. Rather, it exercises monetary control by operating on ‘spreads’. The Bank of Canada operates with two versions, the first an application of the Baltensberger ‘2 for 1’ rule being a clear case of ‘the spread instrument’. Consider paper clearings. When the interest rate on positive settlement balances is held at zero, when the Bank raises the rate it charges on negative settlement balances, it raises the costs to banks of pursuing portfolio policies leading to negative settlement balances. The banks therefore supply fewer overdrafts which result in an increase in the overnight rate, which it is assumed, is carried forward to the term structure of all overdrafts. For the non-bank private sector, the costs of pursuing negative financial savings has increased and capital formation will be reduced. This is the standard explanation of how an increase in Bank Rate is supposed to affect real aggregate demand. Because the interest rate paid on positive settlement balances is left at zero, the opportunity cost of holding such balances rises. Banks will therefore seek to discourage private deposits reducing the possibility of the emergence of positive settlement balances by raising implicitly the price of pursuing savings.

The theoretical point is that by increasing its spread, the Bank is attempting to cause banks to raise theirs, causing therefore the private sector to reduce both its capital formation and savings.

The second version is that in which the Bank operates with ‘bands’. The Bank disturbs a banking equilibrium by raising the rate it charges on negative settlement balances and the rate it pays on positive settlement balances, with the ‘spread’ unchanged, in hopes of raising the overnight rate. The objective is to raise rates on the term structure of overdrafts in general. Less clearly stated by the Bank is that the raising of the band lowers the opportunity cost of banks having positive settlement balances which encourages the banks to raise rates on deposits and encouraging the non-bank private sector to increase its savings. The second version is directed to affecting aggregate demand supposedly lowering capital formation and raising savings.

If these versions were tied to the existence of fiat money bases, then it can be argued the Bank cannot affect either the composition or level of aggregate demand. If the Bank were to believe that aggregate demand were to increase in an inflationary way (not an once rise in the price level), the Bank would raise the ‘bands’ hoping nominal rates on overdrafts and deposits would rise sufficiently not merely to offset any inflationary expectations but to damp down aggregate demand. If there exists a base then ‘real balance effects’ and so forth would prevent the Bank from being concerned that its inflation objective in setting its policy might have any lasting effects on the composition and level of aggregate demand and employment.

Once the existence of fiat money bases is called into question, the Keynesian problem and Banks’ effects on real variables reappears.

On productivity

The measurement of total factor productivity involves two concepts of technical change or residuals. A deep capital concept is involved - that of the difference between reproducible capital and the waiting undertaking by the owners of capital. It is this conceptual matter which separates out two concepts of total factor productivity; the Hicks-Solow-Jorgenson (HSJ) concept and the Harrod-Robinson (HR) concept. The HSJ residual for industry is self-contained whereas the HR residual cannot be calculated without knowledge of the HR residuals in all the other industries, including the industry itself if the gross output is duplicated in the sense that industry purchases some of its own output as intermediate input (eg. the telephone industry using its own services) in its production. The Harrod-Robinson conception is a general equilibrium concept of total factor productivity reflecting the technological interdependence of inter-industry production relationships in modern economics.

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13 See Thomas K. Rymes, **ON CONCEPTS OF CAPITAL AND TECHNICAL CHANGE** (Cambridge, CUP, 1971) and **ON CONCEPTS AND MEASURES OF MULTIFACTOR PRODUCTIVITY IN CANADA, 1961-81** (with Alexandra Cas) (Cambridge: Cambridge University Press, 1991. For an agreement with the Harrod-Robinson concept, see the late Edward F. Denison, “The growth accounting tradition and proximate sources of growth”, eds. A. Szimai et. al., **EXPLAINING ECONOMIC GROWTH: Essays in Honour of Angus Maddison** (Amsterdam: North Holland, 1993), 52
Consider the following accounts for a 'stylized' competitive bank in the contemporary Canadian context

\[ i_{OD}O_D \% i_{OT}O_T \% d_{OD}O_D \% d_{OT}O_T \]

\[ \& i_{DD}D_D \& i_{DT}D_T \% d_{DD}D_D \% d_{DT}D_T \% i_{CR}C_R \]

\[ \% (i_{OD} \& i_{R_D}D_D \% (i_{OT} \& i_{R_T}T_T) \% d_{OD}O_D \% d_{OT}O_T \]

where the notation is standard, save for bank profits \( p \) (the subscript for banking is implied), but \( i_{OD}O_D \) stands for the interest rate(s) and nominal amounts of demand loans (called overdrafts), \( i_{OT}O_T \) for time overdrafts and similarly for demand and time deposits and the \( d \)'s stand for service charges or carrying charges, expressed as rates, the bank may levy for services rendered with overdrafts and deposits. The entries \( i_{CR}C_R \) and \( i_{DR}D_R \) refer to interest receipts of the bank should it experience positive settlement balances in clearings with the Central Bank and interest payments should it experience negative settlement balances. The entry \( d_{CB}(C_R \% D_R) \) represents carrying charges the Bank might levy on the bank's settlement balances for services rendered.

Ignore the entries pertaining to the Bank for a moment. Reference or 'pure' rates are conceived such that the gross output of a bank becomes

\[ (i_{OD} \& i_{R_D}D_D \% (i_{OT} \& i_{R_T}T_T) \% d_{OD}O_D \% d_{OT}O_T \]

so that i) if the same reference rate \( i_{R_D} \) is used for demand overdrafts and demand deposits and \( i_{R_T} \) for time overdrafts and deposits and it is assumed that banks pursue balanced equilibria portfolio policies such that \( O_D \% D_D \) and \( O_T \% D_T \), then \( i_{R_D}D_D \% i_{R_T}T_T \% O_T \), as does \( i_{R_T}T_T \% i_{R_T}D_T \% O_D \) and the accounts for the bank are unchanged. However, if one argues, for example, that individuals are 'paying' for the services of banks by foregoing the reference rate on (say) demand deposits and actually obtain a low (sometimes zero) rate of interest on such deposits, the measure \( [(i_{R_D} \& i_{D_D}) % d_{D_D}]_D \) is the 'true' price times quantity with respect to demand deposits where it is assumed that while \( d_{D_D} \) is the actual market rental or carrying cost of demand deposits, \( i_{R_D} \& i_{D_D} \) is the implicit carrying cost involved in the willingness of depositors, to hold deposits and earn only \( i_{R_D} \) on their lendings to the bank, compared to \( i_{R_D} \). Similarly, the measure

\[ [(i_{D_D} \& i_{D_D}) % d_{D_D}]_D \]
is the 'true' price times quantity with respect to demand overdrafts where again it is assumed that while \( d_{D_p} \) is the actual market carrying cost of demand overdrafts, \( i_{D_p} \& i_{R_p} \) is the implicit carrying cost involved in the willingness of overdrafters to hold overdrafts when the borrowing rate of interest exceeds the reference rate. The reference rates seem to embody the idea that if borrowers and lenders could get together costlessly\(^{14}\) the reference rate would be the costless borrowing-lending rate. Similar arguments would be made for the time overdrafts and deposits with a higher reference or 'pure' rate.

Central Banks and Reference Rates

If the reference rate is crucial for the measurement of bank output and if the reference rate is affected by Bank policy, then it is important to understand how the Bank affects bank output and productivity.

We begin by examining one of the inputs into banks noted above: the service charges the Bank may levy for the transactions and portfolio services it provides to banks (or through their House if that intermediary were taken into account) together with any interest paid on negative settlement balances plus any interest received on positive settlement balances. In other words, I assume that the Bank's gross output is

\[
i_{D_i}, D_r \& i_{C_i}, C_r \% d_{CB}(D_r\%C_r)
\]

which is, of course, subject to the same problem which holds for private banks. It should therefore be transformed in the standard UN way, that is,

\[
[i_{C_i}, \% d_{CB}] D_r \% [i_{C_i}, \% d_{CB}] C_r
\]

where again \( i \) is a pure reference rate. We say therefore that banks who clear through the Bank and run negative and positive settlement balances obtain liquidity services from the Bank such that, given an explicit service charge levied by the Bank, there are what I shall call Bagehot or implicit prices paid by banks for liquidity or lender of last resort services provided by the Bank. In the case of banks running negative settlement balances, the Bagehot price is \( i_{D_i} \& \) while for those running positive settlement balances, it is \( i_{C_i} \).

It is the property of the Bagehot prices set by the Bank that banks' portfolio policies (ie. their overdrafts and deposits) would be such that the bank's expected negative (positive) settlement balances would be zero, if and only if the Bank is neutral with respect to the setting of settlement balance positions.

The opportunity cost of a bank being in an expected negative settlement balance is the Bagehot price \( i_{D_i} \& \) if \( i \) were the overnight rate the bank could earn on demand overdrafts. The opportunity cost

\(^{14}\) For comments on how meaningful such an assumption of such costlessness is, see Robert W. Clower, "On the origin of monetary exchange", Economic Inquiry, XXXIII, October 1995, 525-36.
of a bank being in an expected positive settlement balance is the Bagehot price $i_{CR}$. If $i$, the reference rate, is half-way between the rate charged on negative settlement balances and that paid on positive settlement balances, then, at the margin it is equally costly for the bank to be in a non zero, positive or negative, expected settlement balance position.

When the price and output of banking and the economy as a whole is that desired by the Bank, no non-neutral action will be undertaken by it. The overall banking system will be in a zero settlement bank position and ‘the’ reference rate - the rate halfway between $i_{Dr}$ and $i_{Cr}$ - will be such that the bank's prices of $[(i_{D} \%_{P})]_{0}$ and $[(i_{D} \%_{P})_{D}]$ and outputs O and D will be that desired by the Bank. The nominal amounts of O and D will be such that the Bank's view as to a desired price level (or rate of change in prices) is also being met.

The Growth Accounts for Banks

We can rewrite (1) in a general way, where we ignore the difference between demand and time overdrafts and deposits, as

$$\frac{(O \%_{P})_{0}}{P} i (D \%_{P})_{D} \frac{D}{P} \omega \frac{W}{P} (R \%_{P})P \omega \frac{K}{P} \omega \frac{P}{P} M \omega \frac{P}{P}$$

$$\frac{P}{P} (D \%_{P})_{Dr} \omega \frac{(O \%_{P})_{D}}{P} \omega \frac{D}{P} \omega \frac{C}{P} \omega \frac{P}{P}$$

where P is the general level of consumption prices.

A representative bank in equilibrium will have $\frac{O}{P}$, $\frac{D}{P}$, $\frac{Dr}{P}$, and $\frac{Cr}{P}$. Then, the HSJ residual for banks would be (where $^\wedge$'s indicate growth rates)

$$[a(\hat{O} \%_{P}) \%_{P} \hat{D} \%_{P})] \& [(? \hat{L} \%_{P}) \%_{P} ?]$$

$$\hat{W} \%_{P} (R \%_{P})P \%_{P} \hat{P} \%_{P} M \%_{P}$$

$$\%_{P} (i_{0} \%_{P}) \%_{P} \hat{d}_{0}) \%_{P} i (i \%_{P} i _{d} \%_{P})$$

The weighted rates of growth in real terms of overdrafts and deposits, the stocks standing for the services of the banks demanded by and supplied to holders of overdrafts and deposits, will be equal to standard measures of the rates of growth of inputs plus the residual. Equally, the weighted rates of growth of the rentals of such inputs will equal the weight rates of growth of their own rates of interest on overdrafts and deposits plus the residual.
The growth accounts expressed for HR residuals would take into account productivity advance in all industries producing inputs used by banks in arriving at that for banks.\textsuperscript{15} In that sense, banking adds no new complication to measures of total factor productivity of the industry or aggregate level.

If the Bank wants to constrain the banks and the economy, it raises the overnight rate by raising the bands where $i_{Dr}^{t} \% 25i$ and $i_{CR}^{t} \% 25i$ (for paper transactions $i_{Dr}^{t} 2i$ and $i_{CR}^{t} 0$, the 2 for 1 rule) become $i_{Dr}^{t} \% 25i$ and $i_{CR}^{t} \% 25i$ so that if the Bank wants $i$ to move to $i^{t}$, it sets $i_{Dr}^{t}$ and $i_{CR}^{t}$ such that $i^{t}$, the rate halfway between, will be higher than $i$. As previously argued, the banks immediately know that the expected cost of being in a negative settlement balance has increased and of being in a positive position has decreased and will adjust their own portfolio policies attempting to contract overdrafts and expand deposits. Their actions result in an immediate rise in the overnight rate and in a general rise in overdraft and deposit rates causing the nonbank public to attempt to shift away from deficit to surplus intertemporal transaction streams, such real effects affecting prices, the ultimate objective of the Bank. The

\textsuperscript{15} The HR residuals therefore may clear up one puzzle with respect to productivity measures in banking. If $\hat{K}$ includes the growth rate of computers (and $\hat{P}$ is the growth rate of the prices of computers), then if $\hat{P}$ reflects a fall in the price of computers whose improving characteristics make them more efficient [in banking!], then the HSJ residuals will show productivity advance in the computer industry with little in banking. Since banks are prime users of computers, it follows that much of the productivity advance in banking shows up as being in the computer industry. The HR residuals would entail

\[ d_{i}(\hat{K}_{j} \& h_{i}) \text{ and } d_{j}(\hat{P}_{i} \& h_{j}) \]

where $\hat{K}_{j}$ is the growth rate of the net stock computers and $h_{i}$ is the HR residual in the computer industry and $\hat{P}_{j}$ is the growth rate of the price of computer. Where the price index of computer is said to be improved [See Robert J. Gordon, \textit{THE MEASUREMENT OF DURABLE GOODS PRICES} (Chicago: University of Chicago Press for the NBER, 1990)], then $\hat{P}_{j} < P_{j}$ and $\hat{K}_{j} > \hat{K}_{j}$. If that is the case then the HSJ residuals for banking would be lower. However, for the HR residuals the $h_{i} > h_{i}$ so that $\hat{K}_{j} \& h_{i}^{t}$, $\hat{K}_{j} \& h_{i}$, and $\hat{P}_{j} \& h_{j}^{t}$, $\hat{P}_{j} \& h_{j}$ and the observed HR residuals in banking, higher then the HSJ residuals, would tend to be invariant to this problem. See my comments on "Computer prices and productivity measurement" in \textit{PRICE MEASUREMENTS AND THEIR USES}, (Chicago: University of Chicago Press for the NBER) and the exchange between Denison and Gordon on the concept of capital in the \textit{Review of Income and Wealth}, XXXIX, March 1993, 89-110.
system entails, of course, that if the overnight rate does not move in accordance with the Bank’s wishes, it can enforce by putting the banking system as a whole into a net negative settlement balance position by a drawdown out of which, no matter how much pre-settlement clearings are attempted in the House, the banks cannot escape until the Bank relents by the reverse redeposit mechanism.

From the argument that banks will try to substitute deposits for overdrafts, in the growth accounting framework one would expect the rate of growth of real overdrafts to fall relative to that of deposits. Since overdrafts determine deposits, however, both would fall and the overall rate of growth of banking output would decline. Temporary equilibrium total factor productivity in banking would decline. There is no observed change in the flow of central banking liquidity services because the net settlement balances position of the banking system remains unchanged at zero. There is also no change in the flow of factor services such as labour and capital in the banking system. Yet what has happened is that the rise in the price of the liquidity services of the Bank has caused the output of the banks to contract. And to the extent that banks gross output enters either as an intermediate input into all other industries and as well into final demand, the observed total factor productivity in the HR framework for all other industries and the aggregate economy would also decline. The fundamental point is that in a monetary economy, the flow of total factor productivity, which is the changing efficiency of the primary inputs such as labour and the flow of waiting attached to the ownership of capital, cannot be ascertained without taking into account the changing cost and quantity of the flow of liquidity services of the banks and the Central Bank!

One could argue that if the banks and the economy adjust quickly the once over rise in the reference rate must be temporary and the steady state equilibrium where the rate of growth of total factor productivity for the banks and the economy would be unaffected by Bank policy reappears. Along the temporary equilibrium path, however, the total factor productivity in banking will be lower. The HSJ residuals for the rest of the economy would be unaffected, because in that framework the fall in productivity in banking would reflect the rise in the relative cost of banking services, which would cause a diminution in the use of banking services in all other industries, resulting in a decline in the output of such industries but not a decline in their productivity.

Similarly, if the Bank lowers the bands, it seeks to shift the banks to pursue portfolio policies involving a relative expansion in overdrafts as compared to deposits and the predicted movement in overdraft and deposits rates, vis-à-vis the lower reference rate, involving the overall economy seeking a deficit intertemporal path. As the growth rate of real overdrafts and deposits rises so does the temporary equilibrium rate of growth of total factor productivity for the banks.

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If Bank policy is effective without use of settlement balance policies, then as real overdrafts and deposits change so, adjusted for the partial elasticity of bank output with respect to settlement balances, will settlement balances without further affecting total factor productivity of the banks. However, if the settlement balance enforcement mechanism is employed, then in the relative contraction case, the relative decrease in real overdrafts and deposits will be associated, temporarily with a rise in real constant dollar net negative settlement balances, a factor which would entail a further reduction in the temporary equilibrium total factor productivity of the banks. In the relative expansion case, the relative increase in real overdrafts and deposits will be associated, again briefly, with a rise in real constant dollar net positive settlement balances, a factor which would positively modify the temporary equilibrium total factor productivity of the banks. Why? The use of negative or positive settlement balances, via redeposit and drawdown mechanisms, to enforce Bank policy with respect to the reference rate adds an element of inefficiency compared with the case where by the market embraces the Bank’s view as to what the reference rate should be.

Since from equilibrium to equilibrium, we would observe, where the Bank’s ‘spreads’ or ‘bands’ policies would result in a changed overnight rate, the observed changes in the banks’ settlement balances would be zero. Yet in the case of a contraction in monetary policy, while the real change in the banks’ inputs would be zero, because of their higher prices, the real flows of services associate with banks overdrafts and deposits would fall. Since these components of the gross outputs of the banks would appear as intermediate and even final inputs into industries na households, the overall economy would be shown as exhibiting a fall in the growth rates of Harrod-Robinson productivity. At the basic level, what is happening is that the supply of liquidity services by the Bank has been reduced, the supply of liquidity service by the banks has also decreased so that for the overall economy one says that the level of output is lower because the flow of liquidity services form the Central bank has fallen, even though the flow of liquidity services in real terms supplied by the Bank is hard to measure.

Return now to the case of demand and time overdrafts and deposits. If the reference rate is the overnight rate (there is in fact a vector of such rates) then while the SNA measurement of output for time overdrafts would involve positive bank output, what about the case of demand overdrafts? In particular, what about the case of overnight loans to the money market? Where it is the case that market participants, those who can sell and repurchase securities with the Bank, will be holding overdrafts at the reference rate, the flow of liquidity services provided by the banks is just matched by the flow of liquidity services provided by the dealers to the banks, thanks to their access to the Bank. (If one takes the reference rate to be (say) the TB rate, then there have been occasions when, in Canada, the overnight fell below the TB rate so that the dealers carried their inventories at a profit.) One would not want to argue in this case that through such

17. The Bank of Canada uses ‘repos’ to enforce its bands, that is, should the overnight rate reach the top of the bands, the Bank becomes lender of first resort to the dealers while should it reach the bottom, the banks make loans (by purchasing and reselling) securities to the Bank.
demand overdrafts the price of bank services had been negative or that an output has turned into an input.\textsuperscript{18}

What such cases demonstrate is the difficulty of incorporating, in any completely satisfactory way, the liquidity services of the Bank as an intermediate input used by the banks in providing their services. (One could expediently take the lower of the Bank's bands as the reference rates for demand overdrafts and deposits but that would encounter the difficulty again that periodically the overnight rate may break the bands.) If one takes the Bank’s upper band (or the House lending rate) as the reference rate this, ignoring the fact that the overnight rate may break through the upper band, encounters the difficulty that it renders the output of the Bank (and the House) nugatory with respect to negative settlement balances (and House debits).

\textbf{Conclusion}

. The measurement of total factor productivity for banks cannot be undertaken without incorporating the services of Central Banks in such measures. The case of Bank neutrality can be imagined as a benchmark in which total factor productivity in banking and the aggregate economy would be unaffected by Bank policy. Since the Bank is \textbf{never} neutral then total factor productivity in banking (and in the HR case for the aggregate economy) is always theoretically affected by Banks policy. It remains to model empirically the transmission mechanism through which Bank policy works in affecting the costs of banking in the context of the measurement problems discussed in this paper to quantity the effects of Bank policy on empirical estimates of total factor productivity.

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February 1999.

\textbf{Appendix}

In this paper, I have set aside the problem of Bank notes. Though they are a vestigial fiat money,

\textsuperscript{18} See Diana Hancock, \textbf{A THEORY OF PRODUCTION FOR THE FINANCIAL FIRM} (Boston: Kluwer Academic Publishers, 1991)
they would seem to play a theoretical role if one argues that Banks exercise monetary control by changing their balance sheets. On the balance sheet of the Bank there are no reserves as liabilities and in a banking equilibrium the negative settlement balances of the banks, which would appear as an asset, would be offset by the positive settlement balances appearing as a liability. The note issue could quite easily be privatized and might even be better produced in terms of the efficiency of the denominations and so forth. In exchange, all that would be necessary is for the Bank to provide its liquidity services to the general public by agreeing to accept deposits of private bank notes by the general public in the event that the general public should become concerned. Of course, the Bank would pay lower rates on such deposits than the private banks would pay and indeed the private bank notes might pay interest so that, save for the lender of last resort function of the Bank in a crisis, there would be no reason to expect members of the general public to hold deposits in equilibrium with the Bank. Fiat money is vanishing, if it has not already disappeared. Any monetary theory such as Pigou-Patinkin real balance effects, the optimum supply of money policy and the associated welfare costs of inflation, based on the existence of such fiat money, has lost, I would argue, its theoretical foundations.