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Universal Basic Income and the Cost Objection: What are we Waiting For?

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Abstract

Among the most common objections to providing everyone with an unconditional basic income is the cost objection. It states that the cost of providing everyone with a decent income floor, beneath which no one would fall, is out of reach for governments and public finance. Income taxes would have to be raised to unacceptable levels to accomplish this, the objection claims. This paper addresses the objection by demonstrating its weaknesses and showing that a universal basic income is affordable. It is in fact more affordable than the current wasteful array of often counter-productive, bureaucratic income security programs. Better results can be achieved with lower costs by implementing basic income, or a guaranteed livable income. This study does not seek any cuts to vital public programs such as universal health care or education to attain the result of a basic income sufficient to cover one's needs for food, modest shelter etc. at all times. Personal income taxes are not raised in this proposal and they could even be cut, while improving health outcomes for individuals and reducing health burdens upon the current system resulting from a presently dysfunctional, outdated income security model.

Keywords: universal basic income, guaranteed income, demogrant, negative income tax, program redundancy, income security

Introduction

An unconditional, universal income sufficient to cover one's basic needs is an old idea that is resurfacing again and gaining some momentum. New forms of precarious employment, technological advances and displacement of workers by robotics, and large-scale offshoring of jobs resulting in record company profits and simultaneous catastrophic income loss for others are among some of the reasons people use to justify the concept of universal basic income (UBI) today. Originally, when the idea first surfaced and gained significant support in North America, it was tested on different segments of the population. At that time the big concern for some people – particularly in the U.S. – was *work ethic*. Wouldn't people drop out of the labour-market in large numbers if they received a UBI (or "guaranteed income" as it was called then)? This notion was the primary focus of the UBI experiments of the 1960s and 70s conducted by the American and Canadian governments. Forget (2011a, 2011b) and Steensland (2008) demonstrate how the results of these experiments undermined the work ethic objection to UBI. This paper will focus on the other main objection to UBI, on which significantly less work and detailed analysis has been carried out.[2]

This study demonstrates that a universal basic income or guaranteed income at a level sufficient to cover essential needs (at the official poverty line or higher) is affordable. It provides a response to a popular objection by many writers who claim otherwise. Their objection is based on inadequate and/or misleading information. This will be demonstrated by analysis of influential publications in the Canadian context, as well as investigating the basis of the objection in more general, non-geographically specific terms. No cuts to vital public programs such as health, education, legal aid etc. are sought in this study. Only program redundancies (sometimes full programs and partial redundancies in other cases) resulting from implementation of UBI are identified, along with other public revenue losses that can be better directed to UBI. The result is to improve the resiliency of health service delivery and access to education, while ensuring universal income security at reduced public cost.

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[2] A rich technical and philosophical literature on work ethic related to UBI exists. In addition to the authors mentioned above, a more philosophical literature can be accessed by exploring the debates between Van Parijs (1995) and White (1997), or the work of Widerquist (2006).

I will outline the cost objection to UBI in section 1 and I will then give several responses to this objection in section 2. In the first response to the cost objection (§ 2.1), I will highlight the savings possibilities of a UBI model in contrast to existing welfare models. The second response (§ 2.2) will address the claim that personal income taxes have to be raised to an unacceptable level to finance UBI by focusing on tax leakages in the existing system. Bureaucratic costs will then be considered separately as a wasteful element in the current welfare system (§ 2.3). This will offer additional financing to UBI. Section 2.4 considers other sources of financing, which could be relied on *if required*. These sources would not require us to raise personal income taxes (or taxes on labour income). This fourth response concentrates on existing economic externalities and free-riding, which if addressed can simultaneously improve the economy, social and health outcomes, and ecological sustainability while raising additional revenue for basic income. An appendix summarizing the findings on program redundancies and other savings commonly overlooked in the cost objection to UBI is included and can serve as a guide to the reader throughout the paper.

In proceeding through the study, incomplete calculations of UBI net costs by prominent authors will be evaluated critically. This allows me to conclude that a UBI at a decent level (at the poverty line or slightly higher, distributed to individuals) is feasible, does not require personal income tax increases and can even lead to personal income tax reductions.

1. The argument: "It is too expensive to give the entire population basic income"

The cost objection to UBI is one of the most persistent arguments against basic income encountered in the literature. It is often reinforced by advocates of UBI in different and unsubstantiated ways. Section 1.1 will briefly present the scale of this problem and objection more generally. A specific presentation of the objection will follow in section 1.2 based on a case study of one country. This will allow for illustration of major omissions in the objection to begin to surface. Recent Canadian studies that strongly put forth the cost objection will be featured with their most important arguments highlighted.

1.1 A common theme in the literature

Critics of UBI, and surprisingly many advocates of the proposal (both strong and weak advocates), claim the financial cost for a UBI at a decent level is out of reach. Critics ignore many savings and other aspects available with UBI implementation. Advocates often fall in to the trap of the critics' incomplete arguments by accepting deficient cost assessments as valid. As a result, many UBI advocates claim that although they support the idea and see its many justifications, the cost issue makes it a distant reality or a barrier that necessitates UBI being introduced at such a low level that renders it almost meaningless.

In the case of Van Parijs (1995) – a strong advocate – he makes a novel and useful argument to surmount this artificial barrier, but it is needlessly complex. Readily available, non-controversial and numerous savings and funding sources exist as I shall demonstrate, and Van Parijs fails to properly consider these. He claims UBI will be insufficient unless society reconsiders jobs as collective 'assets'; a potentially large new political project that may put off implementation of UBI for an unacceptable amount of time. White (1997) – a moderate/tentative advocate – agrees with Van Parijs that UBI will not be substantial without jobs being considered as collective assets (although White rejects this proposal).

Numerical justification is sorely lacking in these types of prominent cost assertions (Van Parijs 1995: 90, 103-06; White 1997: 315, 321-22, 326). This study rejects the critics' cost objection as well as the weak positions of UBI advocates on the cost issue. Savings arising from implementation of UBI present a much greater amount of financing than both critics and most advocates seem to realize.

1.2 A country-specific illustration of the cost objection

In a major study produced for the Canadian Centre for Policy Alternatives (CCPA), a think tank supported by

the Canadian Labour Congress, unions and other "national progressive organizations",[3] Margot Young (Associate Professor of Law, University of British Columbia) and James Mulvale (Associate Dean of the Faculty of Social Work, University of Regina) (2009: 24) provide such examples as to the cost of UBI, or GI (Guaranteed Income), for Canada:

Grants paid to Individuals (population data 2006)

Program	Cost (billions)
Grant of $15,000 per year paid to all individuals age 18 and over	$392
Grant of $15,000 per year to individuals age 18 and over, plus a demogrant of $4,000 per year for each child under 18	$418
Payments only to individuals and families below the poverty line to bring them up to the LICO (i.e. reduction of poverty to zero) (2003 data)	$21.5

With the exception of the third option, these are large numbers relative to the scale of the Canadian economy ($1.45 trillion GDP in 2006; over $44,000 for every man, woman and child in the country [Statistics Canada 2007a], and over $1.8 trillion GDP in 2013 [Statistics Canada 2013][4]). In a separate section of their Table 1, below these intimidating numbers, Young and Mulvale (2009: 24) outline the "Cost of existing income security programs (2005)." These include Old Age Supplement, Child Tax Benefit, Provincial payments to individuals (e.g. income assistance) and four other items totalling $135 billion per year. The net cost of the "relatively generous guaranteed income option" above ($15,000 per adult, $4,000 per child) according to them is $286 billion, and they state that "It thus appears that a full-fledged version of guaranteed income is out of our immediate financial reach" (Young and Mulvale 2009: 25).

In a footnote at the end of the study linked to the $286 billion figure above (n 55), Young and Mulvale write that "This figure does not take account of the additional income tax that would be paid with a guaranteed income system in place. This additional revenue could lower the net cost of the benefit by 20 to 30 per cent" (Young and Mulvale 2009: 34). They do not specify where this additional income tax generation will come from; whether it is from the obvious fact that people's incomes will be higher by the UBI amount, thus corresponding with a higher income tax bracket, or other possibilities in addition to this. And they do not provide the dollar figure of this lower net cost item, which is valued as high as $85.8 billion.[5] Other possibilities for additional income tax generation are numerous with introduction of UBI and Young and Mulvale may therefore be underestimating this aspect. For example, Krozer (2010) explains the economic multiplier effect UBI will have through broadening and deepening endogenous consumption. The removal of labour-market work disincentives linked with existing welfare programs offers greater labour force participation and resulting increases in taxable income, as a second example. Emery et al. (2013: 11-14) provide additional reasons for why productivity and labour-force participation are currently depressed, which UBI/GAI is uniquely suited to address based on their results obtained from analysing other universal income security programs. Young and Mulvale's total net cost for UBI could thus be reduced by up to $86 billion, and possibly more, on this point alone.[6]

[3] BC Teachers' Federation, "Historical Perspectives: The Canadian Centre for Policy Alternatives", Jan/Feb 2007 https://www.bctf.ca/publications/NewsmagArticle.aspx?id=10456

[4] Also, Canada's underground economy is valued at over $40 billion annually, not including illegal activities such as drug trafficking and prostitution, with construction, finance, real estate, rental and leasing and holding companies making up the largest components of this unrecorded trade according to Statistics Canada (2014).

[5] Thirty percent of $286 billion.

[6] Clawback or supplemental tax back rates applied to UBI are not included here, and provide much higher net cost savings than 30 percent. Increasing amounts and forms of unpaid labour internationally (Perlin 2012; Pereira 2009) are also a problem UBI can mitigate, helping make currently unpaid (or underpaid) labour paid (or fairly paid) and thereby increasing personal income and income tax revenue. Other forms of taxes beyond income taxes are not taken into consideration by Young and Mulvale's footnote comment, which includes increased consumption and other taxes when people have a UBI as opposed to much smaller – or no –

The LICO level Young and Mulvale use above is one measure of the poverty line (Low income cut-off), with its after tax level for a family of 1 person being approximately $15,000 for the comparable years of 2005 and 2006 (but as high as $17,570 in urban areas with populations of 500,000 and over). Families of 2 persons are deemed by Statistics Canada to have a poverty line income level (after tax) of approximately $18,000 per year under this measurement (but as high as $21,384 in urban areas with the largest populations). Families of 3 and 4 persons have poverty line income levels of approximately $22,000 and $27,000 respectively for 2005-06 (Statistics Canada 2007b: 18).

In his presentation to the North American Basic Income Guarantee Conference in Toronto in 2012, Jonathan Rhys Kesselman (Professor, School of Public Policy, Simon Fraser University and Canada Research Chair in Public Finance) made similar and stronger claims that a UBI is not feasible in Canada. In a subsequent essay Kesselman (2013) repeatedly claims the cost of implementing a UBI is "gargantuan" and leads off with an example of a benefit of $10,000 per capita. "With Canada's population of 35 million" Kesselman writes, "the gross budgetary cost of this basic income clocks in at a massive $350 billion." He states further:

> Even offsetting this figure by eliminating seniors' cash benefits and provincial welfare, the implied additional cost to taxpayers would be enormous… Income taxes on individuals and businesses as well as other taxes would need to be sharply increased. The general public would not tolerate such tax hikes… (Kesselman 2013: Sect. 4)

Kesselman's numbers are repeated by others in the popular press. In a media article reporting on the 2012 Basic Income Congress in Toronto, a $380 billion figure is given as the cost for a universal GAI (Guaranteed Annual Income) in Canada based on Kesselman's presentation (Ternette 2012). The article goes on to summarize Kesselman as stating that the cost "would require a 25 per cent increase in income tax on the highest earners. He said that would not be acceptable to Canadian taxpayers, recommended we forget about a GAI and instead improve our welfare state" (Ternette 2012). Similarly, CCPA Senior Economist and prominent Canadian anti-poverty activist Armine Yalnizyan repeatedly points to Kesselman's work as a deterrent to GAI/basic income, citing the same $380 billion figure as a main reason.[7]

It is important to note how other strong claims are linked to the cost objection i.e. UBI is too expensive, *and the increased taxation required is not politically feasible*. Raising "all households above the poverty line carries severe hurdles of… public finance and political feasibility that proponents typically neglect" (Kesselman 2013: Introduction). Kesselman (2013: Sect. 4) writes that "the personal tax system would be applied to finance the system". This is a common argument among objectors to UBI based on cost; that the amount of new *personal* income tax that would have to be applied makes it a prohibitive policy.

2. Four Responses: Savings and Other Income Sources

This section will explore items that the cost objection to UBI fails to consider or develop in reducing the net cost of UBI implementation. Four categories of items will be explored, providing four responses to the objection. Section 2.1 will respond to the savings issue by considering additional available savings from the replacement of existing income security programs missed by the cost objection. These programs are often inefficient, wasteful or disproportionately benefit the highest income recipients in contradiction of the original intent of such programs to provide income security to all. They can be considered to be redundant with

income currently. VAT rates in Europe are regularly well above 20% (European Commission 2014: 3). Combined federal and provincial sales taxes in Canada are usually between 12 and 15% (Munroe 2013).

[7] Yalnizyan is referenced at the end of a CCPA article citing the $380 billion annual cost amount by a member of the CCPA (her own organization) by way of an update to the article in the 'responses' section on March 3, 2014, and Yalnizyan points to Kesselman's work for justification. See Shaun Loney, "A Province with No Poverty," Policy Fix, *CCPA-MB*, February 28, 2014: http://policyfix.ca/2014/02/28/a-province-with-no-poverty/; Also, Reddit Canadian Politics, "I Am Armine Yalnizyan, Ask Me Anything," reddit.com, March 1, 2014: "I'm not a big fan of the minimum income a) huge cost… $380B for a liberating level of guaranteed annual income according to SFU economist Rhys Kesselman… I strongly recommend Rhys Kessleman's [sic] work on the guaranteed income". Yalnizyan provides a link to the same Kesselman *Inroads Journal* article cited in this chapter. In discussions with Glen Hodgson and Andrew Coyne, Yalnizyan reaffirms her support of Kesselman's work as the main objection to GAI/basic income (available online, Feb. 1 2014, "I'm in Kesselman's camp on GAI").

introduction of UBI; redirecting these program funds to UBI can be considered a much fairer universal benefit that comes much closer to the original intent of these various programs to increase income security.

Section 2.2 responds to the claim that personal income tax would have to be raised to an unacceptable level to fund UBI. This is not true as there are significant leakages in the existing tax system, which can provide a large amount of funding without raising taxes. Section 2.3 will consider the cost of bureaucracy. This response demonstrates that bureaucratic costs associated with existing program spending have not been factored into the net costing for UBI. Section 2.4 will consider new sources of income through pricing of current externalities and free-riding as an additional source of financing for UBI (if required). This includes prevention of environmental and social dumping, and curbing harmful activities such as excessive financial speculation.

2.1 First Response: Savings from replacement of existing income security programs

In this sub-section, two leading cost objections to UBI in Canada will be briefly critiqued for their narrow savings considerations. The program redundancies available by implementing UBI are greater than presented in these studies. A parallel will be drawn with other nations that have similarly elaborate bureaucratic welfare states as Canada. These states should also consider a far greater number of savings items when drawing up cost assessments for UBI at the national level. I will then explain various programs and existing costs that can be considered as savings if a UBI is implemented – both in Canada and in countries with equivalent programs and costs. Starting with the RRSP tax shelter, I will demonstrate the redundancies that are missed by the cost objectors in arriving at the mistaken conclusion that UBI is financially out of reach for governments. This is a conclusion only reached by neglecting numerous existing costs that are redundant with, and better addressed by, UBI.

While Young and Mulvale (2009) do identify some of the savings to be realized from a basic income program, Kesselman (2013) emphasizes the $350 billion cost figure without identifying any total program costs that become redundant or unnecessary with introduction of basic income. The replacement of some existing income security systems made possible by UBI will provide a significant amount of savings for funding UBI. Young and Mulvale identify seven programs that are, or could be seen as, redundant with a basic income in place, but do not go further. There are many more programs and savings to be considered. The seven programs they list are: Old Age Supplement ($29 bn), Child Tax Benefit ($9 bn), Provincial payments to individuals/welfare payments ($32 bn), GST and other tax credits ($15 bn), Employment Insurance ($14 bn), Local payments to individuals ($3 bn), and a seventh item treated in a confusing manner because it is first included then excluded in a subset of their Table 1 (with the subset including two other items equivalent in cost), namely Canada Pension Plan/Quebec Pension Plan (CPP/QPP) ($32 bn). The CPP/QPP is properly excluded ultimately by Young and Mulvale because it is a contributory scheme, and I would argue the same for Employment Insurance (EI) which is curiously treated differently by Young and Mulvale and included in the list of programs to be eliminated with introduction of UBI.

In Canada, as in many other countries, seven such items (or six if EI is maintained) that reduce the net cost of UBI would be considered a very short list. There are many more forms of income security and related programs that can be considered as redundancies with introduction of UBI, specifically a UBI at the level Young and Mulvale identify which meets the goal of ensuring no individual's income is below the poverty line.[8]

The RRSP program (Registered Retirement Savings Plan) is one of dozens such programs that is not mentioned by any of the authors above. It is a retirement income supplement program and tax-shelter that disproportionately benefits high income earners, contributing to the regressive tax system currently in place (nominally progressive, but regressive once such skewed programs, benefits, deductions and other

[8] And as we have seen with poverty line income statistics (i.e. LICO) many multiple-person households will be far ahead of household poverty lines if recipients have an at poverty line UBI distributed per individual, because combined income households can extend incomes further. For example, a doubling of rent, mortgage or living space is not required if adding a second person to a household.

advantages are factored in).[9] There was $775 billion of assets in Canadian RRSPs in 2011 (CBC 2013) accumulating tax-free growth from stock markets and other investments. Annual tax deductions alone from the RRSP program (and similar registered pension plan – RPP) cost the federal government $20 billion per year with two-thirds of this benefit going to the richest 10% of Canadians (Department of Finance 2014: 18; Lee and Ivanova 2013: 23-26; CAW n.d.). This is exclusive of foregone tax revenue on unearned income within this tax shelter. These figures also do not include the provincial portion of income tax deducted and refunded to RRSP (and RPP) contributors. Only 24% of eligible tax filers contributed to the program in 2011 (down from 26% in 2010) (CBC 2013), as many are too indebted, underemployed, precariously employed, unemployed or working full time and earning too little to have the necessary disposable income to take advantage of such schemes. "Many low-income Canadians can actually be worse-off if they contribute to an RRSP" (CAW n.d.).

Other similar programs that are not considered by the cost objectors as unnecessary with the income security provided by basic income include the TFSA tax shelter (Tax-Free Savings Accounts),[10] RESPs (Registered Education Savings Plans) and numerous other tax shelters with even far less potential to help anyone in need than these three mentioned above (Taylor 2007).[11] Charitable programs and the associated donation and tax deduction system, with highly favourable tax deduction rates could also be vastly reduced or eliminated with a basic income in place. Whereas almost 30 percent of Canadians claimed charitable donations in the early 1990s, the figure was 23 percent in 2011. "Fewer and fewer people are donating larger amounts… And spouses with higher incomes can also claim contributions made by their partners" (Simms 2013). Almost six million Canadian tax filers claimed charitable contributions in 2011. In addition to billions of dollars in donations annually to the 'poverty industry' as some have called the growing charitable sector, and the favourable tax deductions associated with them, charities also often receive additional funds and grants from various levels of government, and in too many cases scandalously high salaries and perks are given to executives and managers of these often otherwise well-meaning endeavours – directing these various costs toward funding a UBI could prove far more efficient and be yet another savings element neglected by the studies.

Summarizing up to this point some of the more obvious additional savings not included in the cost objections, one finds up to $86 billion or more in the Young and Mulvale study which they have indirectly alluded to but not calculated, nor have they used this item (additional income tax generation with a guaranteed income in place) to reduce the net cost of UBI implementation as they indicate should be done. Perhaps it is an overly cautious move. If so, their conclusion based on an unjustifiably higher number that "a full-fledged version of guaranteed income is out of our immediate financial reach" needs to be pre-empted. Perhaps it was an oversight of the study, despite the general point being made in a footnote. This item, and its many dimensions, is likely worth more than $86 billion as I have detailed in Section 1, thus reducing Young and Mulvale's "full-fledged" UBI cost from $286 billion down to under $200 billion. The RRSP program - and RPP - offers $20 billion in federal tax deduction savings alone (not including supplemental provincial tax rates and associated deductions, and not including tax-sheltered growth or dividend income from corporate shares on $775 billion in RRSP-held assets). This brings the cost of a *decent* UBI down to well under $180 billion. These two items reduce Young and Mulvale's costing of UBI by well over $100 billion, and bring down Kesselman's costing far more.

Eliminating the RRSP program will also remove the tax-sheltering component of this program containing assets of $775 billion (as of 2011). Growth of 6% on these assets represents $46.5 billion. For comparison, the Toronto stock market gained almost 10 percent in the most recent year (2013) while American stock markets gained between 26.5 and 38 percent in the same year (Morrison 2013). Lee and Ivanova (2013: 24) show that 0.89% of all tax filers in 2010 claimed 50% of all capital gains (those with incomes over $250,000 per year). If capital gains were not tax sheltered in RRSPs, the highest income

[9] "Governments rely on a regressive tax structure as a source of public revenue. (Regressive taxes are those that take away a higher proportion of income from the low-income groups than from the high-income groups.)" Quote from Canada, Croll Report (1971: 46, or p. 74 of 241 in available online versions of the Report). Numerous examples are given in the Croll Report of regressive taxation, many of which have been exacerbated since its publication decades ago.

[10] www.tfsa.gc.ca

[11] As explained in the Financial Post (Heath 2011) "Rental real estate has been described by some as the equivalent of a super-charged RRSP".

brackets that claim a disproportionate majority of this benefit would pay over 40% (CRA 2014a) in tax (combined federal and provincial rates) on this *unearned income*.[12] Applying a more conservative 35% tax rate to $46.5 billion for the sake of estimation produces an additional $16.3 billion in annual savings better directed to UBI (not including dividend income received in RRSPs). This brings Young and Mulvale's $286 billion cost now to below $164 billion; an additional $122.3 billion in savings from two easily identifiable[13] and non-controversial sources ($86bn in additional income tax generation at prevailing rates plus $36.3bn in RRSP program savings). Their costing, upon which they base their negative conclusion, is 43% lower at this early stage of analysing the proposal.

Tax-Free Savings Accounts introduced in 2008, and mentioned briefly above, represent another inefficient new savings and income security program. Milligan (2012: 3) writes that "the bulk of the total contributions come from high-wealth families who still make large TFSA contributions on top of any 'float' held outside the TFSA." This program is similar to the Individual Savings Account program in the UK, introduced in that country in 1997 (Milligan 2012: 7). Adding new programs and financial and accounting complexity in this manner (Department of Finance 2009), to benefit the highest income earners makes no sense if the goal is to improve economic or income security for all. Specialized tax advice to co-ordinate these various programs and numerous details within them for maximum benefit is also only available at significant cost to high-wealth individuals (Milligan 2012: 7; Department of Finance 2009). Using a conservative estimation from Milligan's study of TFSAs I will include a $3 billion annual savings from cancellation of this program/tax-shelter that could be better used toward implementation of UBI. Numerous other non-RRSP and non-TFSA tax-shelter programs referenced earlier in this section, which are not practical to individually cost here, will be estimated at an additional conservative $3 billion combined.[14] This represents an additional $6 billion of savings not factored into the net cost figures, or $128.3 billion in missed savings thus far.

Several program and other public costs are implicated in the annual cost of poverty to society. The savings available in this respect from providing a decent UBI at, or slightly above, the poverty-line income level totals $72 to $86 billion annually in Canada (Rainer 2012; Canada Without Poverty n.d.; Laurie 2008; Rainer and Ernst 2014). "Poverty's demand on health care alone may now approach $40 billion per year" in Canada (Rainer and Ernst 2014). Reduced public costs for health, crime and other factors make up this large total savings item. If one-third of this cost is stripped out due to some overlapping items with those already presented above, we have $53 billion in average savings per year (2007 dollars), bringing the UBI net cost in Young and Mulvale's study down from $286 billion to $105 billion ($181 billion in missed savings). This is 63% lower than the net cost for UBI presented by Young and Mulvale for their generous version of basic income, and 70% lower than the $350 billion cost presented by Kesselman.[15]

Responding to a leading national newspaper columnist's article critiquing the $32 billion cost of raising all Canadians out of poverty with cash transfers, Rainer and Ernst (2014) reply that the cost of poverty alone is between $72 billion and $86 billion annually. This leads them to ask the opposite question the cost objectors ask, namely 'how can we not afford a basic annual income?' The $32 billion 'cost' figure, which disappears into a surplus of savings with introduction of basic income, is based on the NIT (negative

[12] There is no justification for *unearned* income to be taxed at a lower rate than *earned* income, and capital gains (outside of RRSPs) achieve this through a legislated 50% "inclusion" rate. This means only 50% of capital gains are subject to tax. This legislated limit has changed several times and was set at a 75% inclusion rate in Canada for a period in the 1990s (CBC 2012). All capital gains/unearned income should be treated as earned income is i.e. without special exclusions, and that is how I have treated capital gains with the removal of the RRSP program. Sale of a principal residence is one exception where all capital gains taxation is excluded. There are certain *lifetime capital gains exemptions* whose existence and/or threshold amounts can be questioned, with additional revenues from such reduced exemptions being better directed universally to UBI. Overheated, volatile and sometimes corrupt stock markets and the companies in them should not be receiving such additional government promotion and incentives to encourage investment in them.

[13] Eliminating the RRSP program provides additional forms of government savings not explored here, representing additional revenue for UBI. For example, special RRSP tax credits for labour-sponsored investment funds means that each level of government provides an additional 15% in tax deductions (30% extra deductions from federal and provincial governments combined [FTQ 2014]). For each $1,000 invested your "investment only costs you $320!" as per the FTQ promotion. Labour-sponsored funds and associated organizations have been involved in major corruption probes in more than one province (Canadian Press 2014; Hopper 2012).

[14] Writing about one category of tax-shelters (not including RRSPs, TFSAs, RESPs, real estate etc.), a tax lawyer specializing in non-profit and charity law states that philanthropic schemes "costs the Canadian governments billions of dollars per year" in tax incentives and tax receipts (Blumberg 2007).

[15] If $132bn in savings identified in Young and Mulvale's proposal is added to the $181bn in *missed savings* identified in this chapter then Kesselman's less generous model of UBI is reduced in cost by $313bn, or 89%.

income tax) version of basic income. We will treat this issue of two versions of UBI (NIT as a "top-up" version of UBI versus upfront payment to all citizens [demogrant version]) at the end of the study, but for now it is useful to continue directly addressing the large figures put forth by cost objection claims as found in Young and Mulvale, and Kesselman. A couple of quotes on this difference are worth introducing at this point though. Young and Mulvale (2009: 15) state that one major Canadian government report in the 1980s "recommended a universal demogrant-based delivery system, rather than a strictly tax-based system [NIT], although [it] argued that either would be effective." Also, Young and Mulvale (2009: 21) indicate that all of their models "assume that a guaranteed income program could be delivered either through a universal demogrant or through a negative income tax."

To conclude this section on savings from program replacement/redundancy and reduction directly linked to implementation of UBI I will limit myself to addressing three more programs and forms of savings. Daycare costs, in its publicly subsidized form and in its extremely expensive private form, can be greatly reduced with a UBI in place. The same will be demonstrated for social housing in various forms. And thirdly, since UBI cost objections are often coupled with advocacy of improvements to the status quo patchwork of welfare programs, it is not accurate to simply calculate the cost of existing welfare payments to individuals in reducing the net cost of UBI. One must reduce the net cost of UBI by not only existing welfare costs, but also by what the cost objectors are proposing in terms of increased funds toward welfare – this is additional funding they would put toward the (admittedly failed) existing system, which would be better directed to UBI. Subsidized institutional daycare, which advocates internationally recommend should be funded at the rate of one percent of GDP (Canadian Labour Congress 2013), totals over $18 billion per year in the Canadian context. Constantly increasing labour-market pressures, arbitrary bureaucratic rules (excluding people from maternity and paternity leave benefits for example) and a perverse approach to economic development sees new forms of extended daycare being offered. In Canada 24-hour a day daycare (an oxymoron), seven days a week, was introduced in Quebec, with one of the main reasons cited being the accommodation of night-shift casino workers in Montreal (Peritz and Gagnon 2000; CBC 2000). "One pilot project at the Montreal Casino operates 24 hours daily, 365 days a year" and the Family Minister in the Quebec government, Nicole Léger, affirms she thinks it "a good idea" (Dougherty and Jelowicki 2000).[16] It is deeply discriminatory that some parents get extended maternity and paternity benefits (public and private benefits in some cases) to care for a new child, while others feel forced to put their children as young as six weeks of age, or even earlier (Québec 2014), in institutions.

A UBI can allow for provision of a decent level of care for all children by parents or those they trust most (family members, close neighbours) when the need may arise. While public expenditure on childcare in Canada is less than 1% of GDP currently, the OECD (2013: 1, 3) indicates that many statistics relating to day-care expenses are underestimated because of the reporting methods, or lack of reporting, by various levels of government on these expenditures to national governments (Canada is specifically identified as having this underreporting/underestimation problem). If the advocated 1% solution (costing over $18 billion per year and supported by many UBI cost objectors) is reduced by about half, because of UBI implementation and the far greater number of options it would introduce to provide both parental and non-parental childcare outside of publicly-subsidized institutions, we could add another $9 billion in savings or funding better directed to UBI. We could also help stem the tide of increasingly destructive new forms of employment that are creating the growing artificial need for unconventional daycare and nightcare. Among those who claim to need childcare overnight because of a lack of care alternatives, income insecurity or job inflexibility, only one in ten say they are prepared to leave their children in centres overnight (Peritz and Gagnon 2000). Clearly it is a trend[17] the overwhelming majority want to avoid. UBI can provide better options.

[16] Putting children on a lower priority than that of servicing 24-hour/overnight gamblers represents an ethical new low, with government as facilitator of this anti-social conduct on both counts – providing the casinos (which many jurisdictions reject as anti-social) and then further enabling addictive gambling behaviour by removing/treating children as obstacles and placing them in government run "care" institutions. This is about as far from "care" (day, night or otherwise) as I have seen the term used. It is an abusive use of language and the comprehensive concept of care.

[17] Mario Régis, head of the association of non-profit daycare centres in Montreal, asks "How far do we want to go? We have to avoid a situation of abuse… children need their parents above all." He also points out the potential for employer abuse using these programs to "take advantage of staff." (Peritz and Gagnon 2000).

Some other aggressive trends that limit care options for children include: the rise in numbers of multiple job workers[18]; the rise in unpaid overtime work (Pereira 2009); dismissals of pregnant women by increasingly brazen employers resulting in loss of maternity leave benefits (Pigg 2009)[19]; and workplace cultures that discourage and penalize employees who take vacation time to which they are entitled (Wadsworth 2013; Herman 2011; Pereira 2009), despite paid vacation entitlement being inferior in Canada and the U.S. to most OECD nations. This is not an exhaustive list, as the weakening of labour unions and other developments in the past two decades have created intense time poverty in North America, which a UBI can help rebalance to significant degree. $9 billion in additional program savings annually from childcare (not to mention private childcare costs which are extremely high) added to $181 billion in missed program savings tallied earlier, totals $190 billion and brings the net cost of UBI down to $96 billion (from the original $286bn [net cost], $350bn or $380bn depending on which cost objection argument referred to).

If people had sufficient and secure minimum income that they could rely on through difficult circumstances (without complicated bureaucratic entanglements, stigma or exclusions) they also would not need to resort to social housing and affiliated programs in most cases. These programs also limit freedom in terms of where one can live, as most social housing is in select locations with a limited variety of home types, and most importantly, long waiting lists in many instances. Many Canadians do not have any special needs when it comes to housing, but are in social housing simply because of a lack of sufficient and stable income (Swanton 2009: 20) in an increasingly precarious work environment. And if they have special needs those should certainly be accommodated and provided for while supporting the desire of many with milder special needs for independent living with a decent universal basic income (and not reducing any of the supporting services they currently receive, a basic principle of the Croll Commission in advocating for guaranteed annual income).

The Toronto Community Housing Corporation is one of North America's largest landlords, housing about 164,000 tenants, with an additional waiting list of over 72,000 (Monserbaaten 2013; Maloney 2014). Canada's 600,000 social housing units receive $3.5 billion annually, cost-shared between federal and provincial governments (Federation of Canadian Municipalities 2013[20]). Under the Direct Rent Supplement Program tenants in Alberta receive money directly from CRCH (Capital Region Housing Corporation 2011: 1) to assist with their housing costs, up to a maximum of $500 per month. Rental subsidies in British Columbia can be up to $683 per month ($8,196 per year) (BC Housing 2010). Different programs involving forgivable loans that CMHC (Canada Mortgage and Housing Corporation) lists as available to real estate developers are valued up to $150,000 per unit (CMHC 2014).[21] Global figures for all this housing complexity, including subsidization programs at the local level of government, are difficult or impossible to encounter. Assuming $5 billion in annual costs and that the majority of people housed in this way or receiving rent supplements are simply lacking stable, sufficient income, UBI could potentially reduce this cost by $4 billion.

The final program savings item I will deal with (and there are many more) here as indicated is the discrepancy between current welfare expenditures and improvements to the welfare system that UBI cost objectors advocate. While Young and Mulvale point out the $32 billion in annual provincial income assistance/welfare payments to individuals that become redundant with UBI and include this as savings against the net cost of UBI implementation, they also call for easier access to welfare and increased payments for those in it (Young and Mulvale, 2009: 31) in lieu of UBI, as is common with many of the cost

[18] The number of Canadians working "at two or more jobs or businesses almost quadrupled (from 208,000 to 787,000), compared with overall employment growth of 61%" from 1976 to 2003 (Statistics Canada 2004).

[19] This is compounded by an extremely weak enforcement regime when it comes to workplace standards violations in Canada (Federal Labour 2006: 192-93, 220-21; Pereira 2009: 55-59). Pigg writes that the "stunning" increase in firings of pregnant women across Ontario is happening in all sectors and human rights advocates claim they have not seen this level of discrimination in two previous recessions and 30 years in the human rights field.

[20] This reference [online] is not officially dated, however it cites "Results of a national survey on housing conducted October 18-22, 2013." Accessed 22 May 2014.

[21] Also see *Investment in Affordable Housing for Ontario: Program Guidelines*, August 2011, 20 (available in the CMHC source above). This money could be directly provided to Canadians as additional funding to UBI so that they could build their own homes, find their own existing homes for purchase or rental options without the restrictions of local and provincial housing authorities and their sometimes corrupt, expensive bureaucracies (section 2.3 on bureaucracy will detail some of this corruption).

objections.[22] They do so because they know the existing system is a failure.[23] But they are not willing to commit to UBI. Therefore, the additional funding advocated for the existing welfare system should be added to actual existing welfare payments, as this would be the total amount of spending (savings for UBI advocates) that would be directed to the current system, but available to UBI financing instead. The UBI cost objection studies are not clear on how much they would increase provincial income assistance/welfare payments by resisting UBI implementation. But if we assume a 50% increase is reasonable (and possibly very conservative given both easier access to the system and increased payments for recipients is advocated) that would add $16 billion in payments. These are pure savings for the UBI advocate, and thus reduce the net cost of UBI to $76 billion (factoring in this $16 billion annual savings with the above $4 billion in annual social housing costs not deducted from net cost yet).

Conclusion: Program savings and redundancy are vastly underestimated

The program savings in this section add up to $210 billion annually. The savings have been conservatively calculated in many respects and could therefore be significantly greater. And there are numerous other programs that could be included to lower UBI net cost from *program savings alone*. Universal public health care has not been affected. There is no intention to cut funding from, or reduce the quality of, publicly delivered health care. Instead, the public health care burden is reduced generating a significant savings in the system with introduction of UBI at a decent level. A major goal of this thesis is to improve health outcomes and to resist any attempts toward privatization or downloading of health costs onto citizens.

This *additional* net cost reduction of $210 billion annually (and proportional equivalents from similar program redundancies in many other countries) has been missed by the UBI cost objection studies, and thus influences negative conclusions on UBI implementation. Net cost has been reduced by almost 75% of Young and Mulvale's $286 billion net cost annual figure. Program savings/redundancies reduce Kesselman's $350 billion annual cost figure by $342 billion ($132 billion in savings identified by Young and Mulvale, plus $210 billion in additional savings identified in this work), or 98%.

A few other significant programs (not a full list) that could be seen as redundant with UBI in place and thereby provide additional savings to finance it include: the WITB (Working Income Tax Benefit, or equivalent EITC in the United States) which Kesselman (2013: Sect. 7) calls for increased cash support to individuals through; various "special public employment projects" which Kesselman (2013: Sect. 7) also calls for increased funding for; and boutique tax benefit programs such as the Senior Homeowners' Property Tax Grant.[24] I invite others to add to the list savings items that they would see as redundant with introduction of a sufficient UBI to ensure coverage of basic needs, and to cost these items. This thesis has gone much farther in this direction than previous available studies encountered, and has space and resource constraints.

The NIT versus demogrant distinction between UBI proposals (two methods of delivery) introduced earlier in this section should also be briefly noted as a reminder when considering the vast cost differential between the two versions. Keeping this distinction in mind as this study proceeds will allow one to see amplified savings that are more visible with NIT, but masked in the UBI cost objections' general approach and focus on the demogrant model. Recall that two key sources – Young and Mulvale's study, and a major Canadian government report on UBI (McDonald Commission report) from the 1980s – clearly state that both delivery methods are effective with the latter source recommending the universal demogrant version. The importance of this distinction is that the starting cost point identified for NIT is $21.5 billion (Young and Mulvale 2009: 24) whereas the starting cost for the demogrant is $418 billion (Young and Mulvale 2009: 24). Both systems can be "calibrated" to achieve the same results (Young and Mulvale 2009: 21).

Taking the $132 billion in savings from existing income security programs identified by Young and

[22] "Welfare programs don't have to remain as they are: they can be made less parsimonious…" (Kesselman 2013: Sect. 1). "For employable people on welfare, particularly singles, benefits are miserly to the point of almost requiring beggary and thievery for bare sustenance. These welfare benefits need to be increased…" (Kesselman 2013: Sect. 7).

[23] For an explicit real-life example of how the existing welfare patchwork constantly creates new hardships for those caught in its numerous programs (welfare, social housing and rent supplements, OSAP student loans etc.) see Laurie (2008: 29-30).

[24] Worth up to $500 each year for seniors 64 years of age or older who own a home in Ontario (See www.fin.gov.on.ca/en/credit/shptg/). This particular program is an example of one that may justify partial redundancy with a UBI in place, whereas many other programs justify full redundancy/elimination with all savings directed to UBI instead.

Mulvale (2009: 25) to reduce UBI cost from $418 billion to a net cost of $286 billion, plus the additional savings identified in this section valued at $210 billion, totals $342 billion in savings. Applying this against the insignificant NIT cost for universal basic income, results in a large-scale surplus of over $300 billion. The demogrant version cost is not as far off the NIT cost as implied.[25]

2.2 Second Response: Inefficiencies and leakages in the existing tax system – No new taxes!

This response will be brief in identifying major areas of tax revenue losses at prevailing rates that could help finance a decent UBI. No new taxation is involved in the analysis. The evasion and avoidance of taxes by those best positioned to take advantage of tax complexity and lax enforcement in specific areas is the concern, and UBI cost objections do not give this sufficient attention. Instead, cost objectors by default resort to the "need" to tax personal/labour incomes at higher rates in order to deal with the unacceptable high cost of UBI and the financing gap it purportedly generates.

The exclusive reliance on the personal income tax system as the only vehicle for addressing the costs of UBI by cost objectors such as Kesselman, Young and Mulvale – although in other places Kesselman for example mentions business taxes as well before reverting to this more exclusive argument and emphasis on the personal system – is misplaced, in several ways. Van Parijs, White and many other international writers on UBI also emphasize the need to tax labour much more aggressively in order to successfully finance basic income, although supportive of the basic income idea. "The personal income tax system would be applied to finance the [basic income] system" Kesselman (2013: Sect. 4) writes in a section entitled "Basic income: Gargantuan costs, unacceptable tax hikes." Young and Mulvale also state that:

> Any version of guaranteed income – whether universal or targeted,… demogrant or through a negative income tax [NIT] – obviously involves substantial government spending. Raising taxes is politically unpopular. So committing substantial public revenue to ensure basic economic security for all is seen by many as beyond the realm of the "reasonably discussable" (Young and Mulvale 2009: 23).

This study has thus far disproved the above strong claim that negative income tax "obviously involves substantial government spending" because in fact there are large-scale savings to be gained (a surplus) by introducing UBI in the NIT form (and in the demogrant form as will be made clearer later). It has already been established (§ 2.1) that NIT and demogrant versions can achieve the same results through calibration and that both can be equally effective, with one major government report favouring demogrant delivery over NIT in assessing both versions for optimal cost and effectiveness. Therefore, if Young and Mulvale (2009: 24) produce a $21.5 billion cost figure for a negative income tax version of UBI that achieves "reduction of poverty to zero", and they produce a limited savings list of redundant programs valued at $132 billion as a result of UBI implementation, there is no need to talk of massive spending involved. What we have is large-scale savings – even if we remove several items from Young and Mulvale's list of savings.[26]

It is confounding when this information is presented and conclusions are reached that a decent UBI appears to be "out of our immediate financial reach" (Young and Mulvale 2009: 25). If taxation is to be discussed, it must start with the existing system and where it is failing to collect legal revenues at prevailing rates. Canada Revenue Agency (CRA) states "When an individual or business does not fully comply with tax legislation, an unfair burden is placed on law-abiding taxpayers… and the integrity of Canada's tax system is jeopardized" (CRA 2014b). The most significant item in this regard is offshore tax havens and the tax evasion and avoidance that occurs through them.

Vast wealth is channelled away from public goods through these shady and secretive offshore

[25] Adding a "clawback" to UBI can make the demogrant version even more similar in cost to the NIT version, depending on what rate the clawback is set at. Since there is such a large surplus to work with, the clawback could be set at a relatively low rate and still achieve a large surplus of public funds by implementing a UBI demogrant.

[26] From their list of $132bn in savings I would start by removing the $14bn item for Employment Insurance as discussed earlier (§ 2.1), as this program should be retained as a contributory scheme. This would result in $118bn in savings from Young and Mulvale's figures, against a cost of $21.5 billion for UBI (NIT version), totalling $96.5bn in savings/surplus from implementing UBI.

jurisdictions, placing additional burdens on those in lower income brackets. Addressing this as a priority, before referring to any personal income tax increases, is a necessity as the existing system is not being honoured or enforced. Related issues of transfer pricing used as a mechanism to artificially lower profit figures, and therefore taxable income, by major corporations also needs to be addressed on the tax side before objecting to program costs, even if the costs for UBI are overestimated. Such issues deal directly with the existing tax system as it stands, and the priority is to ensure fair and progressive rates of taxation are actually collected under current rules before raising the scare of personal income tax increases. During this "golden age for corporate profits" some of the largest multinational companies are paying zero tax, and receiving tax refunds and subsidies simultaneously (Buchheit 2013).

> How many Canadian tax dollars are we losing to tax havens? …There are three independent estimates that put the figure as high as $80 billion a year that federal and provincial governments are losing to various forms of tax evasion. A recent Statistics Canada report showed that a quarter of all Canadian direct investment abroad was going to countries that have been identified as tax havens. Barbados was the destination for $53 billion in 2011 (CPJ 2012; Canadians for Tax Fairness n.d.).

As concerns developing countries, tax havens facilitate transfer pricing, capital flight and corruption worth ten times the value of aid received by these countries (CPJ 2012). In the UK one of numerous high profile stories recently involved the American multinational company Starbucks repeatedly claiming annual financial losses despite making billions of pounds in profits. Transfer pricing allows such corporations to use offshore tax havens and other mechanisms to misprice transactions between companies in a group (Clinch 2012). The issue affects all countries and their ability to provide public goods, including UBI.

If we take the $342 billion in total savings available from UBI implementation identified thus far ($132 billion in savings from Young and Mulvale's net costing plus additional savings of $210 billion detailed in section 2.1) and add the $80 billion in tax leakage from Canada to offshore tax havens each year, a large surplus is further built up by implementing the NIT version of UBI, as well as surpluses achieved by implementing the demogrant version of UBI as costed by multiple proposals in the cost objection. And recall there is little difference between both NIT and demogrant versions in the final analysis, which has not been clarified sufficiently in the cost objection.

To be conservative let us take half of the amount of the $80 billion in tax leakage identified, instead of the full amount, realizing that severe penalties apply to unpaid/avoided/evaded taxes. This $40 billion annual figure means that we have $382 billion in savings and tax leakage/lost revenue from the existing system to put toward a decent UBI. This overshadows the cost of the NIT version of UBI put forth in the cost objection, and it surpasses the universal demogrant UBI cost Kesselman puts forward by over $30 billion (a $32 billion dollar surplus, without any personal income tax rises).

Section 2.3 Third Response: Freedom from bureaucracy

This response highlights the waste of bureaucracy entailed with numerous programs that fail to achieve what a decent UBI can achieve in most cases.[27] It is a brief response that largely focuses on the real-life case of an individual experiencing multiple welfare bureaucracies. The complexity of this patchwork is overwhelming to individuals experiencing it directly. Sorting out all the bureaucracies and their costs is not worthwhile or necessary here. What is important is to convey this complexity and demonstrate that the costs of bureaucracy are often overlooked in the cost objection and not included in addition to the various program costs it is associated with.

Monitoring people, co-ordinating hundreds of arbitrary and ever-changing rules, ensuring people are destitute first before qualifying for welfare or social housing adds excessive complexity to government. It

[27] Health care bureaucracy is not affected in this discussion. Again, the commitment in this thesis is to high quality publicly delivered healthcare, with no intention of moving in the direction of private health care delivery as is commonly associated with the U.S.

also wastes a great deal of time and other resources on both sides of this divide. Potential recipients fill out many forms, travel to various offices, make appeals, get rejected and humiliated, try another process or program. Bureaucrats – from the lowest ranking staff to the highest paid managers – could be engaged in much more productive and rewarding work.

Maintaining numerous offices, tribunals, employees and data control to carry this all out, micro-managing people's lives, costs a great deal of public money that is not sufficiently acknowledged in the cost objection. For example, we read about the cost of existing income assistance payments to individuals or families in the tens of billions, or the cost of building a social housing unit, or the maximum allowable monthly rent supplement in any jurisdiction. However, the bureaucratic cost is often excluded or ignored.

All this complexity is produced because people simply lack sufficient and stable income in most cases. An extended illustration is valuable here:

> Ali lived in subsidized housing as he grew up with his parents and younger sister and brother. The family has been in Canada since 1994. Ali's family receives Ontario Disability Support Plan payments as his father is disabled. His mother works part time but makes very little. They came from the Refugee camps in Kenya.
>
> Ali… had a part time job since he was 17 and (as a child) none of his earnings reduced the family's ODSP payments. He was able to help a bit with household expenses from his earnings.
>
> When Ali turned 18, the family lost the $105 or so monthly payments from the (exempted) federal Canada Child Tax Benefit. The family needed this money and Ali was able to make it up by getting more hours where he worked.
>
> As the fall approached, Ali and his family realized that it was not going to be possible for him to attend [post-secondary] school full time. It was not just the absence of savings or the loss of the $105 in child benefits. He just needed more money to make a go of it. He also discovered that 50% of his net earnings of about $600 a month would now be deducted from his father's ODSP cheque (as Ali was now no longer a dependent child and was no longer in secondary school).
>
> At the same time, the Housing authority notified Ali's parents that their rent would be increasing given that Ali was over age 16, had graduated from secondary school, was not going to school full time, and was making over $75 a month. The rental increase (effective immediately) was another $90 a month. The cumulative loss of $490 a month in lost child benefits, deducted earnings, and increased rent was too much to lose so he made new plans to go to school part time and perhaps make some more money to make up the losses.
>
> Ali anticipated correctly that his OSAP [Ontario School Assistance Program] entitlement would go down due to his part time status but he worried that he had to input his gross income earned on the OSAP application.
>
> But did OSAP know that ODSP deducted 50% of his net pay? Did they take into account the rental increase? There is nowhere on the OSAP form to note that you are in public housing. How would OSAP know about the rental charge? When he tried to ask, he was told to submit his application and he would get an answer in due course. OSAP simply doesn't answer these questions.
>
> At the end of the summer, Ali came to the reluctant realization that he could not remain at

> home with almost $300 of his net pay coming off his family's ODSP payment along with the $90 increase in rent. Like so many others in his situation, Ali moved out and established his legal residence at a friend's house.
>
> He became what is known by many public housing kids as a 'couch rider'…
>
> In the ensuing months, couch riding did not prove too conducive to studying and working at the same time so Ali gave up his courses and started to look for another part time job to cobble together with his existing job.
>
> Just about the time he got a letter demanding that the small amount of OSAP that he received be repaid with interest, his mother got a letter from 'housing' noting that without Ali in the house, the family was 'overhoused' and no longer qualified for their apartment and that the family would have to leave… (Laurie 2008: 29).

The story gets worse from there. Basic income at a decent level could help millions of people avoid all this arbitrary complexity and bureaucratic overlap. The negative life impacts that come with it are avoidable. Incurring all this bureaucratic overhead to make people's lives so miserable and difficult represents public funds that would be much better directed to UBI.

All these large bureaucracies also make government less transparent and therefore less accountable. It becomes exceedingly difficult to penetrate all their workings, and numerous opportunities for patronage and corruption arise (Montreal Gazette 2011, Alcoba 2013[28]). Better to have fewer bureaucracies operating at the highest levels of transparency, accountability and ethics than having public money scattered in too many conflicting directions.

This complexity has worsened since the early 1970s when guaranteed annual income/UBI was advocated in the Croll Report (Canada 1971). And from that government report four decades ago we could see the profligate waste of bureaucracy. "The cost of administering all this complexity is staggering… to issue one twenty-five-cent bus ticket, in terms of time and energy, cost the welfare system about four dollars!" (Canada 1971: 87). Already in 1971 the Croll Report was critical of "…innumerable welfare administrations and social-service organizations in Canada. The luxuriant growth of government and quasi-government agencies…" (Canada 1971: 67) which has only increased since then.

Without adding bureaucratic costs that are missed in the cost objection arguments our savings figures from implementation of UBI remain at $342 billion (§ 2.1) plus $40 billion in tax losses from the existing system annually (§ 2.2). This $382 billion annual total stands against a $30 billion 'cost' for a negative income tax version of UBI put forth by Kesselman, resulting in a $352 billion surplus/savings without any tax increases. The demogrant version of UBI is costed at $350 billion by Kesselman, resulting in a $32 billion savings/surplus from UBI implementation. And as stated, the cost of both versions of UBI is similar, with one version (demogrant) paying UBI upfront in monthly installments and the other paying it as a negative income tax or 'top-up' at the end of the year. The demogrant will be paid back in part or in full by the end of the year depending on the income received by those in formal labour-market employment (and depending on the amount of unearned income received by those in or out of formal market employment), as well as through consumption taxes and other taxes paid by those who had no income, or insignificant income, prior to UBI.

Bureaucratic costs add to these savings to be gained by UBI implementation. These bureaucratic costs are best calculated elsewhere due to constraints (time, resources, space) and because they are not required to demonstrate the feasibility of UBI. One guiding point in this area of cost and savings worth emphasizing is the 16:1 ratio highlighted in the Croll Report above in terms of bureaucracy costs required to issue benefits in the form of one bus ticket. This is not necessarily the case with most welfare bureaucracy

[28] "…a damning report from the city's auditor-general that uncovered lavish employee expenses [at TCHC – Toronto Community Housing Corporation]. That probe also found staff repeatedly single-sourced contracts, sometimes without appropriate documentation, or split orders in order to get around procedures that would require board approval for big ticket items."

today, but we have all heard of charities that despite relying on large amounts of volunteer labour still often waste a large portion, or even the majority, of their financial contributions on administration and salaries. Public bureaucracy uses often well-paid staff and high paid managers to execute the oppression detailed above, without volunteers (who would volunteer for such an awful task?). It is therefore not good policy to multiply bureaucracies or increase their size where it is not absolutely necessary and where cash payments/basic income can be far more effective.

2.4 Fourth Response: Externalities and current free-riding

Dumping toxins in the air, land or water at little or no private cost leads to tremendous public costs. This occurs in the form of health costs. It can occur in the form of aesthetic damage, such as the death of diverse natural spaces used for recreation, which often earn public revenue. The loss of inland fisheries, or the loss of local food security due to polluted land or groundwater, necessitates often lower quality imports and expensive new infrastructure to make this feasible. These are some examples of ecological dumping. As David Suzuki (2008) and James Hansen (2009) have argued, exacting a proper levy on the use of the commons can mitigate such destructive activity and bring it down to a sustainable level while generating large revenues for a 'green dividend' or green component to basic income.[29]

New forms of free labour being extracted from populations, especially younger demographics entering the workforce, in the form of unpaid overtime work, unpaid internships, excessive hours worked without premium pay previously associated with these extra hours, deliberate misclassification of employees as self-employed etc. all represent social dumping (Perlin 2012; Pereira 2009; Standing 2009). Even more extreme versions of it involve the horrible vision of suicide nets placed outside the factory of mobile phone producer Foxconn (Trenholm 2012) as a twenty-first century solution to degrading labour. Off-shoring of labour has led to incredible profits for corporations like Apple, which is directly linked to Foxconn, as they carry out social and ecological dumping simultaneously with such moves.

These externalities and free-riding have public costs, some of which UBI can help turn into savings. This response to the cost objection will explore some of these possibilities, starting with health costs incurred as a result of deteriorating labour conditions, which UBI can help rebalance. When faced with growing job and income precarity employees are less likely to speak up or confront such abusive conditions for fear of losing their income and their mortgaged homes etc. UBI offers some ability to confront this degradation because a minimal, decent income is guaranteed. It may not be as high as your job income and it may not cover the expensive monthly payments on a large home and car, but it would always allow you to live in modest dignity and not miss a rent payment (or modest mortgage payment/refinancing), or see you through a difficult patch for an extended time. This will allow many more people to voice important concerns that are currently silenced, and if the situation is unbearable they could eventually choose to leave rather than sacrifice their health (or commit suicide) if the employer fails to improve the situation.

No new taxation of labour income, or personal income tax increases, are required to achieve this generation of revenue, which can help protect the commons, improve the functioning of the economy and dramatically reduce public health costs. Curbing harmful financial speculation through modest levies has long been discussed for its great revenue generating capacity in contrast to the almost negligible size of such levies (beginning with Tobin tax and many possible variations of it). Ecological, social and speculation (financial, real estate and other) costs are often borne by the victims of these activities, with perpetrators externalizing these costs into the public realm – free-riding. Corporate subsidies ("corporate welfare") is yet another version of this phenomenon. It recently cost global citizens trillions of dollars in the form of bailouts to banking, financial, auto and other corporations.

[29] Some anti-ecological activities such as nuclear power and its waste generation need to be banned outright, as several countries and other jurisdictions have already done. Many toxic chemicals are also not needed in food or other products – organic food production should be pursued much more actively. However, destructive mining activities to produce luxury items and many other unnecessary consumer goods for example should have much higher prices attached to them to reflect this ecological harm, if local communities have accepted the mining activity. Excessively large vehicles (SUVs), sports vehicles (cars, boats etc.) simply purchased as status items and burning excessive amounts of fuel are additional examples of items that should have a much higher 'true-price' for the damage they cause to the commons and greater amount of resources required in their production and daily usage/emissions, if society is not willing to ban these products outright.

Starting with social-labour dumping that is continually intensifying, in the Canadian context alone we find $33 billion in annual health costs, or savings available (MacQueen 2007; Pereira 2009), if this situation were addressed. In the past this type of abuse was countered through strong labour movements at the national level. The labour movement has not provided a successful response to these recent challenges of deterioration, partly because of the dynamics of globalization. A UBI can mitigate a lot of this harm by empowering people with a minimal amount of control or say, and security, in their working lives, which does not currently exist (the majority of workplaces being non-unionized in Canada). This can provide an opportunity for new forms of collective response *and* for labour unions to become more relevant to desperate employees seeking an improvement in the labour-market. Too many people have no hope or income security in confronting the challenges of rising stress, burnout and workplace disability associated with modern workplaces costing us $33 billion annually. “Stress is part of an explosion in workplace mental health issues” (MacQueen 2007), which is only intensifying with eroding income security.

Taking two-thirds of this $33 billion current cost, which is entirely avoidable, totals an additional $22 billion in indirect savings for UBI. One-third of this large amount is conservatively left in place to account for those who will continue to overwork themselves in pursuit of career objectives. But there is no reason why UBI cannot achieve better than this in restoring a healthy balance between work and life. Adding this amount to the total of $382 billion in available savings/revenue toward UBI implementation identified in sections 2.1 - 2.3 above, results in $404 billion in accumulated savings/revenue thus far available, without increasing taxes on labour.

Continuing with externalities, dumping and free-riding that impose public costs on society that can be mitigated and recouped through fair-pricing, let us consider the ideas of leading environmental thinkers and practitioners David Suzuki and James Hansen (former head of NASA’s Goddard Institute). Hansen (2009) argues a much more efficient and effective environmental proposal to address pollution and climate change than those currently on offer would be “fee and dividend” (carbon fee). His model based on usage of oil, gas and coal in the United States in 2007 would yield $600 billion per year and result in a dividend for each adult American of $3,000 per year. David Suzuki (2008) as Canada’s leading environmental thinker and personality sees even greater yields available in his modelling, while improving economic performance, sustainability and social well-being.

Taking one-tenth of the more conservative American figure above (approximate Canadian population relative to the U.S.) can result in an additional $60 billion in financing for a green dividend or green component of UBI ($3,000 in additional UBI per adult). This has the simultaneous benefit of addressing urgent global, national and local environmental priorities. Adding this figure to the $404 billion in savings/revenue available to UBI totals $464 billion. A large surplus is created by applying this figure to any of the most pessimistic and simplistic of cost assessments/objections to UBI, whether considering the NIT or demogrant versions of the idea.

We can still consider much-needed speculation levies (on financial and land speculation), as well as corporate welfare giveaways before even needing to discuss personal income tax increases that the cost objection assumes is required from the outset. The surpluses demonstrated so far show that taxes on labour (labour-market income) could even be cut.

3. Conclusion

Without raising any personal income taxes this study has shown that universal basic income is not too expensive to implement as a public policy. Savings from program replacement and redundancy make up the majority of the rationale for this argument. Public universal health care as a cherished institution/program has not been cut to achieve any program savings or financing for UBI. Implementing UBI in fact helps improve the health system by reducing unnecessary burdens upon it. The financial surplus generated by implementing a UBI (in either negative income tax or demogrant versions) can actually lead to a personal income tax reduction if so desired.

Savings from bureaucracy have not been costed or calculated, which would only make the case for UBI even stronger. Other revenue generating possibilities that do not include taxing labour, and which are

non-controversial, such as taxing financial or land speculation have not been included in the net costing or financing of UBI here. A surplus is achieved by implementing UBI even without these additional non-controversial financing options.

Total savings of $342 billion (§ 2.1) from redundant and/or ineffective programs alone exceeds the Young and Mulvale cost of $21.5 billion for an NIT version of UBI (well over $300 billion in savings/surplus). As discussed, the NIT and demogrant versions of UBI, the latter having much higher costs attached to it in the cost objection argument, are not that dissimilar in terms of final cost.[30] The cost objection ignores the manner in which UBI is paid back in the demogrant version to arrive at a similar final cost to the NIT version. Total savings (§ 2.1) plus leakages in the existing tax system (§ 2.2) largely from tax havens and practices carried out through them total $382 billion – far exceeding Kesselman's pessimistic costing of a demogrant version of UBI for Canada. Kesselman in his cost objection does not include any savings figures for UBI, nor does he address tax leakages and inefficiencies in the existing system that could be used to finance UBI. He simply jumps to the "need" to tax labour/personal incomes at "unacceptably" high rates to fund basic income. That has been proven false.

In the last two of four responses to the cost objection (§ 2.3 and 2.4) I demonstrate how additional financing can be generated to further increase the surplus available by implementing UBI. These last two responses are only costed in a very limited manner and can generate far greater revenues. Thus, it is the existing welfare system and status quo with inefficient, often counter-productive programs that is too expensive.

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[30] For additional support on this point see Pasma and Mulvale (2009: 2) in which they state: "Although the cost for the government's budget is greater than with an NIT, the end cost to taxpayers is not necessarily higher, since those with higher incomes pay the benefit back through their taxes. As well, the program may be cheaper to administer than an NIT because of the greater simplicity of its administration."

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Appendix:

Missed Savings and Redundancies in the UBI Cost Objection: A Summary

Young and Mulvale (2009) cost a "generous" UBI – enough to raise all Canadians out of income poverty – at $418 billion annually and find savings of $132 billion (leaving the Canada Pension Plan/Quebec Pension Plan untouched). This provides a net cost of $286 billion annually in their study, leading them to conclude UBI is financially out of reach. Kesselman (2013) costs UBI at $350 billion and provides no savings figures. Here are missed savings items that these studies failed to consider or cost to reduce the net cost (and even provide a surplus) for UBI. This is a summary of what is detailed in this study with a few additional items for consideration marked with an asterisk:

Item or Program	**Missed Savings (Billions)**	Missed Savings Subtotal
Additional tax revenue generation (at prevailing rates)	$86	
RRSP	$36.3	$122.3
TFSAs	$3	$125.3
Other tax shelters	$3	$128.3
Cost of poverty	$53	$181.3
Daycare - partial redundancy	$9	$190.3
Social housing (& related programs) – partial redundancy	$4	$194.3
Additional income assistance/welfare advocated in the cost objection (to status quo programs)	$16	$210.3
WITB (EITC equivalent in the U.S.)	not costed	
Special public employment projects advocated in the cost objection	not costed	
Homeowner's Property Tax Grant	not costed	
Charitable tax deduction programs and gov't grants (foodbanks, poverty alleviation)	not costed	
Corporate welfare/subsidy programs	not costed	
Sunshine list of excessive/high salaries in the public service*		
Total Missed Savings/Redundancies	**$210.3**	
PLUS: Tax leakage – current system		
Offshore tax havens/related evasion and tax avoidance	$40	$250.3
PLUS: Bureaucracy savings		
Welfare elimination, social housing reduction, daycare reduction, OSAP etc.	not costed	$250.3
PLUS: Externalities/current free-riding		
Social-labour dumping, health costs	$22	$272.3
Green dividend/carbon fee	$60	$332.3
Tobin tax and/or variations at the national level (financial speculation levies)	not costed	
Land speculation levy	not costed	
Taxing *unearned income* at the same rate as earned income*		
Total Missed Savings, tax leakage (in current system) and new revenue from pricing externalities	**$332.3**	

Adding this missed savings total (preventing externalities can also be considered savings, as this reduces public costs) to existing savings identified in Young and Mulvale (2009) of $132 billion, **totals $464 billion in savings** to be gained by implementing UBI.

Many items above have been costed partially or conservatively as explained throughout the chapter, leading to a greater potential for savings/surplus as a result of implementing a decent universal basic income. Several items have not been costed, leading to even greater savings than what is presented here.

Again on Piketty's *Capital in the Twenty-First Century*

or Why National Accounts and Three Simple Laws Should not be a Substitute for Economic Theory

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Abstract

This paper reviews Piketty's book *Capital in the 21st Century*. Although the facts described by Piketty are widely indisputable, the paper criticizes the actual economic theory underlying the central thesis of the book, and this on two main points: first the nature and thus the consistency of capital, and second the direction of causality. The paper discusses first the confusion made by Piketty between "capital" and "wealth" which for him cover the same economic reality, and shows that productive capital, real estate capital and net financial assets cannot be put on the same conceptual level. Secondly, it shows that the rate of return on capital as the ultimate explanatory factor for the growth in inequalities does not hold, because Piketty's three laws are not acceptable as such: the first one is a mere tautology, the second implies the identity of the long-term growth rates of income and capital, and for the third law the fact that r is greater than g is not in itself a sufficient condition for β and therefore α to increase. Even in Piketty's analysis it is not really r but s, the owners of capital's consumption choices, which drive capital accumulation. The paper finally proposes an alternative explanation for the evolution of developed economies over the last 35 years.

Key Words: Piketty, capital, rate of return, inequality, income sharing

Above all, we should acknowledge the enormous amount of work accomplished by Thomas Piketty in his book, *Capital in the twenty-first century*[2], in reconstituting data on capital, its rate of return and its distribution, for the major developed economies and over two centuries. If the starting point of all science is firstly to describe facts and measure variables that express them, it is indeed in this case an inescapable scientific approach, and one which had never been carried out so far with this depth and width. We can therefore only express admiration for the importance of the task so performed.

But Thomas Piketty does not limit himself to the mere description of facts. After bringing them to light, he also attempts to give an explanation based in theory, and intended to be very simple, since it is essentially based on three formulas, or "laws", quite basic and therefore easy to understand. This is part of what makes the deserved success of this book. But as we will attempt to show, it is also at this level that a number of reservations can be expressed as to the status and therefore the relevance of this underlying theory.

Let us begin by saying that the distribution of wealth is at the heart of economic theory because it is the central question of the organization and functioning of any human society. And this is so whether we consider wealth as incomes, which are flows, or as assets, which are stock variables.

Let us recall the outline of Thomas Piketty's approach. It is based on national accounts, which deliver annual accounts for different categories of economic agents, considered as "institutional sectors". These accounts provide annual data on the formation, decomposition and use of incomes from their creation as primary incomes in the production process. For quite a number of years now these national accounts also provide data on assets. The annual series from these accounts finally tell us about the evolution of the variables involved. For earlier periods prior to the creation of national accounts, Piketty has reconstructed

[1] Author contact: cflamant1@gmail.com I would like to express my grateful thanks to Mr. Norbert Haering, who was the first reader of a former version of this article. His comments and advice have been very helpful in helping me to draft a second version which I hope is more meaningful. Any remaining errors are obviously mine.

[2] *Capital in the twenty-first century*, Cambridge, MA: Belknap Press, March 2014 (English translation). However the page numbers for the quotes refer to the French edition.

data relevant to its analysis using all conceivable historical sources.

Our author is primarily interested in inequalities in household incomes and wealth, and ultimately it is households that are directly or indirectly - through stock ownership - the owners of the other economic agents, with the exception of the government or more exactly public administrations. These other agents are (to make it short) firms and banks and financial institutions. As Piketty's approach is a macroeconomic one, he is led to aggregate or consolidate in household accounts the accounts of these other agents. Once the statistical data are compiled and presented through numerous tables and graphs, and knowing moreover that, adopting the point of view of households, Piketty explicitly equates wealth and capital, his thesis can be summarized as follows:

- he notes that the capital has a rate of return "r", which he considers as an essentially technical data, and as such a largely uncontrollable one, since it is external to the economic system. This rate of return seems to him to be linked primarily to the productivity of capital. This rate of return varies little in the long run, and stays around 5%, in real terms, with perhaps a small downward trend in recent years, which would bring it closer to 4 or 4.5%.

- however, this rate of return is higher than the rate of GDP-growth "g" which has declined for some time and seems more likely to settle at around 1.5 or 1 % in real terms over the coming decades. Thus capital will grow faster than income (capital intensity, i.e. the β ratio between capital and income, will increase), which will mechanically increase the share α of capital income in aggregate income. Inequalities in wealth as well as in incomes will thus increase in proportions that will soon become unbearable. To avoid this predicament Piketty, as the good tax expert he is, calls therefore for the implementation of a progressive tax on capital.

Although the facts described by Piketty are largely indisputable, apart from minor methodological points regarding the reconstitution of time series, the economic theory underlying the central thesis of the book needs to be criticized on two main points: the first concerns the nature and thus the consistency of capital, and the second concerns the explaining factors highlighted by Piketty, because of the contradictions that his own approach brings about. These two points will be discussed in turn in the first two sections, before we provide some elements of an alternative explanation in a third section.

1. The nature and consistency of capital

For Piketty the words capital and wealth cover the same economic reality, since as he himself points out (page 84 of the book): "We will use the words 'capital' and 'wealth' interchangeably, as perfect synonymous".

This confusion between capital and wealth does not affect the validity of Piketty's figures concerning inequalities, but it is a source of problems for the interpretation and comprehension of the mechanisms behind the rise in inequalities. To be sure, this conflation between capital and wealth has been mentioned by a number of authors, and in particular by VAROUFAKIS[3]. But they generally fail to underline that this position of Piketty exactly reflects the rules of national accounting. These conventions correspond to the methodologies, definitions, accounting rules and classifications that can be found for instance at the international level in the European System of Accounts, and in the present context in balance sheet accounts[4]. On this basis the right translation for the French word "patrimoine", might have been "net worth", rather than "wealth", since the balancing item of a balance sheet is called net worth, but this is not such an important problem. It is on this same basis that Piketty indicates therefore that capital consists of non-financial assets (consisting in the sub-categories of produced and non-produced non-financial assets, such

[3] Varoufakis, Y. (2014). Egalitarianism's latest foe: a critical review of Thomas Piketty's *Capital in the Twenty-First Century*, *Real-World Economics Review*, 69, Section 2, 19-21.
[4] The conventions regarding balance sheets can be found in chapter 7, Balance sheets, 169-192, of the European manual published by the European Commission for the European System of Accounts – ESA 2010.

as land and natural resources), and net financial assets. Apart from inventories, produced non-financial assets consist of productive capital and real estate capital.

VAROUFAKIS rightly points out that this definition of aggregate capital is creating various problems at the conceptual level, and therefore at the level of economic theory itself, in particular as regards the definition of rates of return, or as he puts it "the link between capital and GDP". But he does not expand on real estate capital, despite the fact that it plays a very important role in Piketty's analysis, since it makes up at times close to 50% of overall wealth. He does not expand either on net financial assets. This is the reason why both these items are discussed below.

1.1 Real estate capital

Firstly, as regards the real estate part of capital, housing is considered as such primarily because of its span of life, and because it is supposed to "produce" housing services, which can be sold on payment of a rent. Thus national accounts assume that households produce and consume housing services. For occupant households owning their own homes this leads even to the complex calculation of a fictional production of imputed housing services, which necessarily implies also fictitious rents.

This is questionable for several reasons. First this leads to overlook the fact that the economic definition (and not the accounting one) most commonly accepted for capital is that it is made of means of production which in the capitalist system are combined by entrepreneurs with wage labor to produce goods or services. But this is usually not the case for housing rented by households, except perhaps for owners of very large real estate portfolios for which housing then takes on the nature of a productive capital.

Second, what also shows the purely conventional nature of the treatment of housing in the national accounts, and thus by Piketty, is that the same reasoning could be applied to almost all consumer durables, which by definition are not immediately destroyed at the time of consumption. Thus, any vehicle can be considered during its entire life (which can be quite long: up to a dozen years or more) as producing transport services. So there is a difference of degree (of lifetime), but no difference in nature, and thus no difference conceptually between housing and other consumer durables.

A final argument, and not the least, deserves to be taken into account: it is that at the macro level national accounts are supposed to only record net flows, and this is indeed what Piketty does when it comes to financial assets, from which liabilities are deduced (we shall come back to that). But the rent paid by a household to rent a home is the rent received by another household, which means that when the global household account is established by aggregating the individual accounts, then paid rent and rent revenue compensate exactly, with a resultant which is zero: it results that rental housing does not create any net income for all households. Thus if there is no income globally, for reasons of pure logic, there can be no corresponding production.

Even though there is indeed the consumption of a "housing service" when a household occupies a home rented from another household owning this same home, this last household is at the same time obviously deprived of the possibility of consuming this same service, which corresponds to a negative consumption. In other words, at macroeconomic level, the global output of an economy remains unchanged when the owner of a house stops using it himself to rent it to a tenant. The variation in the net amount of consumption for both households is therefore zero, which shows that we are here in presence of a notable fallacy of composition, something that is central to Keynesian economics. This corresponds also to the fact that this housing service has not been produced in the period by the combination of labor and productive capital: it has been produced potentially at the very time of production of the house (which is anyway the convention of national accounts for consumer durables).

Let us conclude that at macroeconomic level and from an economic point of view, not an accounting one, revenues corresponding to housing are created on the occasion of the production of new housing. The buyer of a new home buys on this occasion the possibility of consuming the corresponding housing services during the whole lifetime of this home. All subsequent transactions involving this home must be considered as a sale of existing assets or used goods, which add nothing to the production of the period and therefore the value of the corresponding product. And this whether these are definitive sales or

rentals, since the last one should be viewed from a macroeconomic point of view as a sale for a temporary period equivalent to the duration of the lease. Therefore rents corresponds only to a remuneration of property, and not to a "rate of return on a capital".

For the three reasons that were just explained and that reinforce each other, let us conclude that housing should be considered not as productive capital (in the economic sense) but as consumer durables. Moreover, it is like this that it seems to be considered in most countries by tax administration (although not in the US), by not allowing the owners (except in certain cases) to deduct any depreciation from their income. But this does not prevent us in any way from viewing housing as a part of wealth. We must realize, however, that this discrepancy is one of substance, which does not relate only to words or simple definition. It follows that rents should not be treated in the same way as profits made by firms through the utilization of productive capital. They cannot be aggregated in a way that conflates both of them under the same concept of rate of return on capital. This explains why, as Piketty recognizes, the "rate of return" on real estate is different from, and in fact lower, than the rate of return on productive capital.

1.2 Financial capital

The criticisms that can be made on the treatment of financial capital are for the main part of a different nature. Financial capital is indeed a significant part of the overall wealth in the richest countries, and even more so of the global wealth of the richest people. Its role has become all the more important in the last forty years, with the financialization of capitalist economies. Furthermore the recent world financial crisis has showed that it can be very disruptive. Obviously Piketty knows that and he also devotes a few pages to the remuneration of financial capital and the evolution of the interest rate, which for him does not seem to be by nature very different from the rate of return on productive capital, which he thinks is why its level is close to this rate of return. But financial capital is almost nonexistent in the statistics and figures provided by Piketty, where wealth is essentially made of real estate and productive capital. Financial capital is therefore ultimately a very small part of global wealth, and this can be related to the absence in Piketty's book of a true theory of the interest rate. As we will now show this derives from the fact that Piketty's approach is a statistical, and not a theoretical one, since it is based on the treatment of financial capital in the System of National Accounts, combined with the fact that he employs too high a level of consolidation of these accounts.

The first point to emphasize is that, in the work of Piketty, financial assets and therefore their income, cover a wide range of elements, since in the national accounts they comprise all financial claims, meaning currency and other deposits, debt securities (short term and long term), loans (short term and long term), equity and investment funds shares or units (not to speak of the gold bullion component of monetary gold). All those assets can be classified into two broad categories: assets that earn interest, on the one hand, and those that pay dividends or income deriving in one way or another from the ownership of productive capital, on the other hand. The latter are linked obviously to capital as it is considered in this article, (fixed or productive capital) and therefore do not deserve particular attention. On the contrary, the first ones correspond to what can be considered as "pure" monetary or financial assets.

With respect to these assets the treatment adopted by Piketty is consistent with national accounts, which consider that "all financial assets have a counterpart liability". This amounts to saying that any financial claim of an institutional sector is a debt of another one. For instance deposits are a claim of households on the banking system (i.e. the Financial Corporations), and simultaneously a liability of the banking system to these same households. Therefore, when as does Piketty we consolidate the assets and liabilities of the different sectors, claims and liabilities are netted off. Net financial assets might not have been excluded from the analysis if this consolidation had concerned only firms (Non-Financial Corporations) and households. However the balance sheet of the sector of Financial Corporations (the banks) is also subject to this consolidation with the balance sheet of the household sector and of non-financial corporations, whereas - in contrast, the government sector (General Government) is excluded from it. Therefore the resulting aggregate is what Piketty names the private sector, as opposed to the public sector at large (the government sector in question). Within such a framework all claims and liabilities between all the economic agents belonging to

the three sectors of households, financial corporations and non-financial corporations compensate in the resulting consolidated balance sheet. As a balancing item of this overall balance sheet of the private sector, there cannot be any other net financial assets than the private sector claims on the public sector, which correspond to the financial net worth of the private sector, equal to the debt of the public sector to the private sector (leaving aside the rest of the world).

Such a high degree of balance sheet consolidation is to some extent inherent in Piketty's analysis, which concerns ultimately the wealth of individuals, which is in national accounts terms reflected in the consolidated balance sheet of the sole institutional sector of households. Indeed since all the banks and financial institutions (the institutional sector of Financial Corporations) are ultimately owned by the households who own their shares, their net worth is ultimately a part of household wealth. Let us note in passing that this (correct) treatment of financial assets leads Piketty to treat interest differently from rents on real estate, since he considers interests - rightly, as an income transfer, which therefore does not correspond to any production, and adds nothing to the overall income or GDP of the economy. This is quite in line with the fact that for national accounts "financial assets are rooted, not in production but in a commitment, that is, they are the counterpart of a liability". Let us just mention in passing that for national accounts banks nevertheless produce financial intermediation services indirectly measured (FISIM).

This high degree of consolidation of household accounts, however normal it may be in a wealth analysis, introduces a theoretical impossibility to understand monetary and financial phenomena. Indeed, and despite the fact that banks produce the means of payment, the banking system disappears from the statistics and the broad picture through the consolidation of its balance sheet (together with the balance sheet of financial corporations) within the balance sheet of the household sector. In any model of a monetary economy, households, firms and banks cannot be consolidated into a single sector. Since on the contrary this is the case here, it is normal that Piketty's theory of capital is incapable of analyzing a financial crisis such as the one which began in 2008.

This brings us to another criticism regarding Piketty's analysis of financial capital, which comes from the fact that, as part of the conventions of the System of National Accounts, the Central Bank is treated as a financial institution, with its balance sheet consolidated within the balance sheet of the institutional sector of Financial Corporations, itself ultimately consolidated within the household balance sheet. Doing so, however, introduces an inconsistency with the way Piketty builds the private sector, with its net financial worth expected to correspond to global household wealth. As it is defined by Piketty, the balance sheet of this private sector includes the balance sheet of the Central Bank, although in most countries it is 100% owned by the government.

This should have implied to depart from the conventions of the system of national accounts by consolidating the Central Bank's balance sheet with that of the General Government. It is true that the assets and liabilities of the Central Bank are always broadly equivalent, with therefore a net worth of its balance sheet close to almost zero. But the consolidation of the household balance sheet with that of the banks makes M3 – M1 disappear from the statistics, and the indirect consolidation of the household balance sheet with the Central Bank balance sheet, through the consolidation of this last one with the bank balance sheet, makes M1 disappear. It follows that the monetary wealth of households corresponding to M3 (currency, deposits, etc.), which should obviously be a part of their net worth, disappears in the meantime. Ultimately, the monetary claims of the households, once their accounts are consolidated with the banks ones, are compensated as a liability of the Central Bank to the economy, and are therefore not a part of the household net worth.

Knowing for instance that the amount of the M3 money supply is in most rich countries not too far from 100% of GDP, which is a significant amount, this inevitably introduces a bias in the numbers, by lowering the overall amount of recorded wealth. This is the explanation of this strange phenomenon, the absence of monetary wealth, which is easy to spot in Piketty's statistics, but which no commentator seems to have noted!

We must therefore acknowledge that money remains ultimately external to Piketty's statistics and analysis in terms of wealth. To be sure, this is consistent with the neo-classical approach to monetary phenomena, for which money is a mere veil, but it prevents Piketty from having any theory of the interest

rate, other than linking it to the rate of return on the other types of capital. This has the inconvenience of disposing of the Keynesian and post-Keynesian monetary theory, but also to ignore some hard facts that are particularly obvious today: in most of the developed world, interest rates have fallen to levels so low that it should be obvious for any honest observer that the nature of interest rate is conceptually very different from the rate of return on capital, to which it can be only loosely related.

Regarding the nature of wealth thus assimilated to capital, let us conclude that things are much less simple than it appears in Piketty's book. As long as wealth means all the property rights of economic agents on a number of assets, both real and monetary or financial, both produced and not produced (land and natural resources), and this regardless of the nature of incomes that their detention can bring, it is a concept that does not in itself suffer criticism. However, when one tries to understand the role of these different types of wealth in the production and distribution of income, as part of an economic theory, to conflate under one unique concept of capital all these elements with so many differences in nature and properties – and to let financial wealth largely disappear from the analysis - appears extremely simplistic and confusing.

As we will now try to show, this initial blur cannot but have an impact on the nature and validity of the explanations given and theories developed in "*Capital in the 21st century*."

2. The need to inverse the order of the determining factors

2.1 The rate of return on capital and the first law of Piketty: α = r x β

In Piketty's book, it is the rate of return r which is the first and fundamental variable, from which the others derive. With regard to its definition, he states that "in all cases, the rate of return on capital measures what capital provides in a year, regardless of the legal form of this income (profits, rents, dividends, interest, royalties, capital gains, etc.), expressed as a percentage of invested capital."

With regard to the determination of this rate of return, Piketty begins by noting that "the rate of return on capital is determined in particular by the following two forces: first technology (what is the capital), and secondly by the abundance of capital stock (too much capital kills the capital)". However, after having conflated them at the beginning of his analysis, he continues by distinguishing capital in the form of real estate and the rest of the capital, as noted: "In all civilizations, the capital serves two major economic functions: firstly to house (that is to say, to produce "housing services" ...), and also as an input to produce other goods and services". This seems indeed justified, but all the more so on the basis of the explanations that we have provided above, which means in another theoretical framework where capital is not defined by its ability to "produce" goods and services. In Piketty's theoretical framework, it is not clear why real estate capital should rely on a different logic: what would in other words differentiate housing services from other services, produced by capital as an input? *Capital in the 21st Century* does not tell us.

Piketty then tells us that in the simplest economic models, "the rate of return should be exactly equal to the marginal productivity of capital" (page 336) even though other influences may come to be added, so that depending on the sectors this rate may be higher or lower. But he specifies that "the concept of marginal productivity of capital is defined independently of the institutions and rules - or the absence of rules – which characterize the sharing between capital and labor in a given society" (page 339). For Piketty, it is therefore clear that the return on capital does not depend on that sharing, while the inverse is true.

Again, it is a regrettable confusion. These explanations fit into the framework of neoclassical theory. But they overlook the fact that even in this context, the theory of marginal productivity explains the rate of return only at the micro level, either for one firm or one commodity, and in the very short term, with the price system (and therefore the rate of return) being given. Moreover the equalization of the rates of return among all branches would require conditions of pure and perfect competition that are never met in the real world.

However Piketty is clearly at the macroeconomic level, and focuses on the long term. This is one reason, among others, why the rate of return is obviously an average, which corresponds to the average productivity, and not to the marginal productivity of capital. It is true that the marginal rate may be equal to the average rate, but that is true only at the maximum level reached by the curve of average productivity. It is unclear how the production of all goods and services produced in an economy where markets are imperfect could be situated simultaneously at a level that corresponds exactly to this point of the curves. Finally, it is

interesting to recall that even for the neo-classical theory, but in one of its most sophisticated versions: the theory of inter-temporal general equilibrium developed in particular by MALINVAUD[5], the model leads to a multiplicity of profit rates.

Piketty's model starts from his first law, which is that the share of capital in total income, i.e. α, is equal to the rate of return r multiplied by the intensity of capital i.e. β (α = r x β). As Piketty himself recognizes, it is in fact a tautology, since it is obvious that the ratio of the share of income from capital to total income α can at all times only be equal to the share of income from capital divided by this capital (i.e. r), multiplied by the ratio of total capital over total income (β), since when we realize the multiplication, capital disappears from the fraction. The transformation of that identity into a law boils down to regard it as a function, where α is a function of r and β, which implies first to determine r elsewhere in the system. But if, as we have shown above, we cannot do it by making r a function of the marginal productivity of capital, because there is no such thing at the macroeconomic level, then we cannot explain α.

The only way out of this indeterminacy is to reverse the problem, taking as its starting point the fact that the rate of return is not a kind of technical or technological element, given as such from outside of the economic system. If it were of a technical nature, it would be difficult to understand how - as Piketty indicates, it was able to change so little over centuries, fluctuating around 5%, while the evolution of technical progress has been at the same time so uneven. On the contrary, if r is an economic (as opposed to technical) variable, it has to be determined within the system, which means that Piketty's first law has to be rewritten such as r = α / β. The only way to calculate r is by knowing the share of capital income in total income α and the intensity of capital β, which implies to know the amount of capital, and thus the price system, as soon as we consider that this capital is made of heterogeneous commodities. But here, as is well recalled again by VAROUFAKIS[6], we know since the Capital Controversies of the 1960s that r must be known in order to determine the price system, which itself must be known to determine r: this is a logical fallacy.

We have therefore three variables, r, α and β, each of them being linked to the two others. We know that r cannot be the determining variable and that r and β are codetermined. This leaves us with α, the income-share of capital, or γ = 1 – α, defined as the income-share of labor, as the only variable that can logically be determining the two other ones. We thus come back to Sraffa's well-known demonstration[7] that in a system with k goods (and k prices), plus the wage w and the rate of profits r, we have k+1 equations (with an additional equation to define the standard) as compared with k+2 variables. Therefore "the number of these exceeds the number of equations by one and the system can move with one degree of freedom; and if one of the variables is fixed the others will be fixed too".

However, and unlike Sraffa, it seems quite impossible to consider, as he does, that the rate of profits "can well be 'given' before the prices are fixed" and "is susceptible of being determined from outside the system of production, in particular by the level of the money rates of interest"[8]. Indeed it has already been mentioned that such a supposed link with the interest rate is more than dubious.

This means that what we are left to choose as the independent variable is w, the level of the money wages, which will give us the price system, and then γ, as the income-share of labor (from which α is the complement to one). This seems all the more justified that the level of monetary wages is indeed determined at a different logical level. It would indeed be hard to deny that the distribution of income and wealth is at the heart of the conflicts which characterize any human society, and corresponds in a capitalist society to the sharing between capital and labor. As such this sharing cannot be the result either of a technological phenomenon that, like the productivity of capital, could be put into equations, or of a monetary phenomenon, like the interest rate. It is rather the outcome of multiple economic, social, cultural, institutional, political and ideological factors.

One can now understand why this sharing is the primary phenomenon: it is because its modalities depend on factors mostly external to the economic theory itself. This sharing results indeed from the balance

[5] See in particular Malinvaud's book: *Lectures on Microeconomic Theory*.
[6] See page 27 in his article mentioned above : "Egalitarianism 's latest foe: a critical review of Thomas Piketty's *Capital in the Twenty-First Century*, *Real-World Economics Review*, 69, Section 2, 19-21.
[7] In *Production of Commodities by Means of Commodities*, page 12.
[8] At the end of Chapter 5 "Uniqueness of the Standard System", page 39 of *Production of commodities by means of Commodities*.

of power which in any society and at any time exists between workers and firms, locally, in the various branches and at national level. It is this phenomenon that is the primary engine of the functioning of any economy.

Finally, let us observe that in the theoretical framework which we have developed here, where houses are – rightly – considered as consumption goods, this conflicts is a conflict over the sharing of consumption goods alone. It is true that labor income can also be saved, lent to capitalists and be invested, but ultimately, at the macroeconomic level, the ownership of the capital goods resulting from the corresponding investments will not belong to those who have saved, but to the capitalists who have borrowed and transformed these savings into investment. Conversely, if a worker decides to invest by himself directly and buy shares or capital goods, he logically becomes an owner of capital, i.e. a capitalist, at least for this part of his activities corresponding to this property.

2.2 The second law of Piketty, β = s / g

VAROUFAKIS discusses Piketty's laws, and in particular his second law β = s / g, exposing the assumptions behind it[9]. He relates these to five different axioms that he criticizes then on various grounds, theoretical as well as empirical. I will not question here Piketty's assumptions, but discuss rather the internal validity and necessary implications of this second law, β = s / g, and the coherence between these implications and the rest of Piketty's analyses.

This formula means that the ratio of capital over income β (the intensity of capital) is equal to the ratio of the net saving rate "s" (itself equal to the ratio of net savings S over income) over the growth rate of output "g". Piketty states that in the long run this equality is always true, making it a law. He further considers that this ratio tends to rise because of the decrease in the growth rate g, which makes β increase. As the rate of return on capital r is postulated to remain constant around 5%, and since α = r x β, then the share of income from capital over total income α should increase to a level that can become socially unbearable.

To check the validity of this law, let us remember that by definition saving is the share of income that is not consumed, and simultaneously the part of the output which is not consumed but invested. As output is equal to income (other things being equal), there is an identity between saving S and investment I, and the net saving rate s (S/Y) is by definition identical to the net investment rate (I/Y). To check the validity of the law, we call K the capital stock, Y the income, and I = dK the net investment, with I equal to the increase ΔK in the capital stock (gross investment) less capital depreciation. Knowing that Piketty calls *∂* this depreciation rate, then we have I = dK = ΔK - *∂*K. Furthermore, the growth rate of the product g is by definition equal to dY/Y. With this notation, Piketty's formula can be rewritten as:

$$\beta = \frac{K}{Y} = \frac{s}{g} = \frac{dK/Y}{dY/Y} \Rightarrow \frac{K}{Y} = \frac{dK}{Y} \times \frac{Y}{dY} \Rightarrow \frac{K}{Y} = \frac{dK}{dY}$$

From which it results necessarily that:

$\frac{dY}{Y} = \frac{dK}{K}$, i.e. g = $\frac{dK}{K} = \frac{I}{K}$ (which is the growth rate of the stock of capital).

This formula implies that the growth rate g of output and income is identical to the growth rate of the capital stock, which means that returns to scale are constant: regardless of the scale of production and income, the ratio β is constant! The law can be reformulated as meaning that in the long-term the growth rate of output is identical to the growth rate of the capital stock, and that the ratio β between capital and income, i.e. the intensity of capital, is therefore constant (as is the average life span of capital if *∂* is constant)!

[9] See pages 22-28 in Varoufakis's article as mentioned above.

In passing it should also be remembered that income and investment are flow variables, since they are defined as monetary values (a priori scalar) distributed or invested during a period. If this period is taken as a unit, ΔK is therefore a scalar per unit of time. However, capital is a stock variable: it is the monetary value of the capital stock measured at time t, so it is a dimensionless variable (a pure scalar). Therefore the $K/\Delta K$ ratio between the capital stock and gross investment during a period is simply the average life of this capital. If the capital stock is constant, implying that net investment is zero ($I = dK = 0$), then the rate of depreciation ∂ is the inverse of the average lifetime.

The law put forward by Piketty is an odd one, since it is based on the identity of the long-term growth rates of income and capital, and thus the long-term stability of the ratio β of capital to income, although it is supposed to lead to a thesis according to which this ratio is due to increase systematically, which is completely contradictory! For the β ratio to rise it is essential that the growth rate of capital (I/K) be greater, and not identical, to the growth rate of income g! This can be demonstrated more concretely using figures provided by Piketty, and from his own findings.

Consider a β ratio equal to 6, and a net rate of return on capital r equal to 5%. This gives us a capital K equal to 600 for an income of 100, with a resulting net capital income amounting to 30 (of which rents amount to 10). If the rate of growth of output and income g is given and equal to 2 % per year, then the saving rate s is given by the formula: $s = \beta \times g$. Hence s is necessarily equal to 12%: net savings S and net investment $I = dK$ are equal to 12. The depreciation rate ∂ being 2%, according to Piketty, the depreciation of capital ∂K is also equal to 12 and therefore the gross investment ΔK (i.e. $I + \partial K$) is 24.

A first apparent paradox can be highlighted: if the rate of depreciation of capital is 2%, the average life of capital should be close to 50 years, whereas with a gross investment of 24 and a capital stock of 600, the average life of capital seems to be 25, but this is related to the fact that the capital stock is not constant, but increases by 2% a year: with such a depreciation rate the capital which has become unproductive or obsolete and as such is removed from the production process is one that has been invested on average 35 years before. We need also to recall that for Piketty capital is divided into two parts, approximately equal: real estate capital and productive capital, that each amount to about 300. However, the average life is not at all the same in both cases: it is surely more than double for real estate capital, implying a depreciation rate of close to 1 % in this case, meaning therefore 3% for productive capital, with an average lifespan of about 50 years in one case and 20 in the other.

With such a model, how do we move to a new ratio β higher than the previous one, for example increased by 50% and equal to 9? Focusing on the output and income structure, and thus putting growth aside, the second law of Piketty shows that with an income of 100, a capital of 900, and still a return on capital of 5%, we get a capital income of 45 (with rents of 15). If the growth rate is still 2%, then the saving rate s is now equal to 18% and net savings and investment $I = dK$ are equal to 18. If the average life of capital and thus the rate of depreciation of capital ∂ have not changed, then the capital depreciation ∂K is 18 and therefore the gross investment ΔK is 36.

One can certainly go from the first situation, where $\beta = 6$, to the next, where $\beta = 9$, but this poses two problems. The first problem is that to go from one to the other requires that the capital stock is growing faster than the income. For example, if the rate of income growth remains at 2 %, and the growth rate of capital rises to 3% per year, it takes a little more than 37 years for the β ratio to rise from 6 to 9. But this assumption of a growth of the capital stock faster by 50% (3% against 2%) contradicts the law itself, which can only be stated if by construction the growth rate of the two variables is the same! If the economy were to stay in this new situation where $\beta = 9$ and for the formula to become valid again, it would be necessary that the rate of capital growth realigns with the growth rate of output, once we have reached this new level where the β coefficient has gone to 9. This could happen either through a decline in the rate of capital growth, which would have to go back to 2%, or through a rise in the rate of output growth, which would have to go up to 3%, or through a combination of both. Thus in the real world the rate of growth of the capital stock can well be lower than g, in which case β would fall, contrary to Piketty's assertion that it cannot but increase.

Another problem is that the law implies constant returns to scale. This is also what is supposed to explain the approximate constancy of the rate of return on capital, by establishing the identity of this rate of return to the "productivity" of capital. However, within the framework of neo-classical theory, the increase in β

should indeed cause a decrease in the rate of return, since in our example we need a capital increased by 50% to get the same income: one goes from K/Y = 6, and therefore Y/K = 16.7 %, to K/Y = 9, or Y/K = 11.1%. In the neo-classical world the reduction in the average productivity of capital is necessarily accompanied by a decrease in its marginal productivity and thus the rate of return on capital. We are therefore in a situation of diminishing returns, which in all neoclassical logic should cause a decrease in the rate of profit, but Piketty himself notes that this is not the case. This is indeed another reason why in the real world the rate of return on capital has actually nothing to do with any marginal productivity.

As a consequence, let us conclude that the formula β = s/g put forward by Piketty is not a law. It is an identity, which is valid only under very special conditions of constant returns and identical and constant growth rates of output and capital. These conditions are similar to what Marx designated in the "Capital" as a situation of simple reproduction. But this formula is by no means a function in the mathematical sense of the term, which could explain the evolution, upwards or downwards, of the intensity of capital, i.e. β. It allows in the long run to compare two situations corresponding to different saving or growth rates, but does not allow to understand why these rates have changed, or how we went from one situation to the other over time. The latter are phenomena that correspond to what Marx called expanded reproduction. They are what Piketty would have to explain in order to provide a theory behind increasing income and wealth inequality.

2.3 The fundamental force of divergence: r > g

Piketty tells us (page 55) that the fundamental inequality r > g, which expresses the fact that the rate of return on capital exceeds the rate of sustainable growth, plays an essential role in the book and summarizes to some extent its overall logic. If growth rates remain low in developed countries, it effectively implies that capital income will rise faster than overall income, so that the share α of capital income in total income will not stop growing, and this would become unsustainable.

Before examining in more detail this argument, however, note that by definition, as α = r x β, there is necessarily an intermediate assumption, which is actually the second fundamental law, already discussed: for α to increase if r remains constant (or even decreases somewhat) it is imperative that β increases. However, and strictly speaking, the increase in β = K/Y does not depend directly on r, but rather on the rate of growth of capital, which must be greater than g, the rate of income growth. In this case the ratio β can only increase, resulting inevitably in an increase of the ratio s/g. And if the growth rate g is constant, for example, around 2 % per year, as a result, it is s that must increase.

The important variable is therefore not r, but s, which is the net saving rate (S/Y), but which is also the net investment rate (I/Y = dK/Y). Piketty is well aware of that, since he writes (page 573): "If g = 1% and r = 5%, then it is sufficient that the owners of important assets choose to reinvest each year more than one fifth of their income from capital for these assets to grow faster than the average income of the society in question."

This example is very interesting because it shows two things. First that it is the dynamics of capital accumulation that are fundamental. Indeed, in a crisis, if the investment rate becomes zero (situation of mere replacement of capital), or negative, then β will stagnate or even decline, and Piketty would deduce that α is expected to stagnate or decline. Secondly, this example shows well that not all capital income is invested: look for example to the case where β = 6 (the capital is equal to 6 times the income). For β to remain constant with a growth rate g equal to 1 %, it is sufficient that dK/K = S/K be equal to 1%, which implies that the rate of net savings S/Y = s be equal to 6 %. Then by definition we have α = r x β = 30 %. The result is that 4/5th of net capital income (30 % - 6 % = 24 % of income Y) are not saved, but consumed! But consumption out of capital income (dividends or direct profits) is largely absent from the book of Piketty. However, regardless of this example, everything shows that in the real world consumption out of capital income takes a higher and higher share of total consumption, with in particular in recent years a phenomenal growth in the consumption of luxury goods.

Let us conclude that the true force of fundamental divergence is not that r is greater than g, but that dK/K is greater than g. Even if r is greater than g, this is not a sufficient condition for β and therefore α to increase. It is not therefore the rate of return on capital, but the rate of capital accumulation I/K, i.e. the

investment behavior of the owners of the capital, which is the determining variable at this level.

Before investing or consuming, you must however have received an income, and since capital income cannot be explained on a theoretical level by capital productivity, it is clear that this income must come before all from the ownership of capital and from the powers attached to it in terms of distribution of income and output. One can thus observe again that it is the variable α, reflecting this distribution or sharing of income, which is logically the first, and which should therefore be the starting point of any analysis. However, it was previously indicated that this distribution cannot be explained in purely economic terms, and at any time depends on the bargaining power of the various actors.

The sharing of income between capital and labor being given, the central value is then the variable s, because it reflects the choice of the owners of capital between consumption and investment. The amount of capital at time t derives from these past choices, throughout the lifetime of accumulated capital. This amount once known, one can finally derive the rate of return on capital $r = \alpha / \beta$. Compared to the analysis of Piketty we can only see that we must reverse the order of explanatory factors[10].

3. Some elements of an alternative explanation

It is out of the question here to embrace two centuries of evolution of capital and revenue sharing, and we will focus on the period following the Second World War. There is a clear break for all variables studied between the so-called "thirty glorious years", going broadly from 1946 to 1974, and the period from the early 1980s to the present. The period 1975-1980 is an intermediate one. If we start from the distribution between capital and labor, and if we try to understand what has changed at this level between the two periods, we are led to highlight the global mode of regulation of the economy of developed countries.

3.1 A brief factual background

For the first period, marked by the post-war reconstruction, we observe that the strong growth (around 5% per year), with a very low unemployment rate, has been accompanied by a roughly equivalent growth of real wages, probably because of the high employee bargaining power associated with low unemployment (around 3%), which led to an approximately constant share of wages in income (around 66% in the Europe of fifteen). This is what has been called the "Fordist" model of regulation[11]. The continuous rise in real wages fed demand, which in turn led to maintaining a high rate of investment, creating a virtuous circle. The investment rate was high enough for the capital stock to increase significantly, particularly as related to the reconstruction. The capital stock increased and the capital/output ratio β stood around 4. The increase of the output corresponded to an increase of about 1% per year of the labor force, and thus to an increase of approximately 4% per year of labor productivity.

In the second period, going roughly from 1980 to the outbreak of the international financial crisis, the unemployment rate was high (around 10%), and the average growth slowed down sharply, to around 2% per year. Real wages stagnated, and the share of wages in income decreased by 7 to 8 percentage points. The growth rate of labor productivity was considerably reduced, and is now around 1%. Growth of the capital stock continued, and the β ratio is approximately 6. Finally, and according to the figures, it is not true that the rate of return remained stable at around 5%. Disregarding the real estate capital, to focus only on productive capital, different studies show that this rate increased from about 13-14% (in terms of gross profit), to about 20-21%.

How did we move from one configuration to the other? To understand this, note that the interim period, which runs from 1974 to 1980, is a transition period that extends between the two oil shocks. After the first shock, since unemployment was very low and the bargaining power of workers was high, firms bore the transfer of income to the oil-producing countries, which resulted in a decline in the share of profits and

[10] This analysis therefore is very different from that of Ann Pettifor and Geoff Tily in their article "Piketty's determinism?" published in *Real-World Economics Review*, no 69, where they emphasize the causal role of the monetary rate of interest, rather than the rate of return on fixed capital, in explaining growth.
[11] On this question, see Aglietta, M. (1976), *Régulation et crises du capitalisme*, Paris, Calmann-Lévy.

the rate of profit. This in turn generated a decline in investment rates, creating the conditions for a rise in unemployment. When the second shock occurred in 1980, increased unemployment and the concomitant decline in the bargaining power of workers were such that real wages started to decelerate, that the wage-share of income declined and that the profit share increased.

Meanwhile, with Thatcherism and Reaganism, the neo-liberal model of regulation was developed. Since 1980, in particular, the world economy has entered a phase of globalization, where foreign direct investment (FDI) has increased enormously. Thus in France, outward FDI has averaged just over 4% of GDP between 1990 and 2011, according to OECD statistics. FDI inflows were far from compensating the phenomenon, representing only 2% of GDP during the same period. The decline in domestic investment rates, already depressed by weak demand, has obviously been aggravated. It is not surprising that the growth of labor productivity has fallen to a very low level.

3.2 A simple model for the two periods

To better understand the nature and consequences of the changes, we can make use of the small model that we used above (pp. 9 and 10) to explain the reasoning of Piketty, but with some recalibration to reflect the criticism made so far. In particular, since Gross Domestic Product (GDP) is the variable most used in national accounts, we will name gross income Y_g and gross investment $I_g = \Delta K$. This model is not intended to represent a particular country for a well specified year, but would rather be representative of an average situation for the main developed countries, for an average year within each of the two major periods discussed above. The United States, however, are supposed to be excluded from the average for the first period, because there was no reconstruction for them. The model is summarized in the table on the next page, which provides all the significant figures for both periods. It will show that, despite using the same assumptions as Piketty's, we do not reach the same conclusions regarding the inevitability of a slow growth leading to a continued rise in inequalities.

To stick to Piketty's approach, we choose to include real estate capital, despite the strong criticism we expressed about that, knowing that it skews the analysis somewhat. Within this framework, the reconstruction period is characterized by data that are fairly close to the example above (page 9). But we assume a β ratio equal to 4, which gives a capital K equal to 400 for a net income Y of 100. If we keep the same rate of depreciation ∂, which is 2% for Piketty, the depreciation of capital equals 8. Therefore with an investment rate of 24% of gross income and Y_g equal to 108, the overall gross investment ΔK amounts to 26, and total net investment I = dK to 18 (26 - 8). We consider that real estate capital is only 150 over 400 and that the net income from rents amounts to 5% of total net income Y, or an absolute amount of 5, which gives us a rate of return on real estate capital of 3.3% (5/150). If the rate of depreciation of real estate capital is 1%, the gross rate of return is 4.3% and its depreciation in absolute value is 1.5. All these figures correspond to Piketty's.

A simple model of both the reconstruction and the post 1980 periods		
	1945-1974	**1980-2008**
Gross income Y_g	108	112
Net income Y	100	100
Net income from total capital	30	37
Net income from real estate capital (rents)	5	8
Net profits on productive capital P	25	29
Gross investment $I_g = \Delta K$	26	22
Gross investment rate $\Delta K/Y_g$	24%	20%
Net investment I = dK (with δ = 2%)	18	10
Capital K	400	600
Real estate capital	150	300
Productive capital	250	300
Global rate of depreciation ∂	2%	2%
Depreciation of capital ∂K	8	12
Rate of depreciation of real estate capital	1%	1%
Depreciation of real estate capital	1.5	3
Depreciation of productive capital	6.5	9
Rate of depreciation of productive capital	2.6%	3%
Gross income from total capital	38	49
Share of gross income from capital in total gross income	35.2%	43.8%
Gross rate of return on total capital	9.5%	8.2%
Net rate of return on total capital	7.5%	6.2%
Gross income from real estate capital = rents	6.5	11
Share of gross income from rents in total gross income	6%	9.8%
Gross rate of return on real estate capital	4.3%	3.7%
Net rate of return on real estate capital	3.3%	2.7%
Gross profits on productive capital P_g	31.5	38
Share of gross profits on productive capital in gross income	29.2%	33.9%
Gross rate of return on productive capital	12.6%	12.7%
Net rate of return on productive capital	10%	9.7%
Net investment in real estate capital (2% of existing capital)	3.0	6.0
Gross investment in real estate capital	4.5	9.0
Gross investment in productive capital	21.5	13
Net investment in productive capital	15.0	4.0
Gross rate of investment in productive capital	19.90%	11.6%
Net rate of investment in productive capital	15.00%	4%
Rate of growth of productive capital	6.00%	1.33%
Total consumption (C = Y – I)	82.0	90.0
Consumption of the owners of total capital	12.0	25.0
Share of consumption from capital income in total consumption	14.6%	27.8%

Isolating now the productive capital, its depreciation in absolute terms is the difference: 8 - 1.5 = 6.5, and the rate of depreciation of productive capital is thus 2.6% (6.5 / 250). If the net capital income amounted to 30, as in the above example, made of 5 for rents plus 25 for profits on productive capital, we deduce that the gross revenues from total capital amount to 38. The ratio between this amount and a gross income Y_g of 108 is 35.2%. The rate of return on total capital is 9.5% for the gross yield (38/400) and 7.5% for the net return (30/400). For productive capital, this corresponds to a gross profit of 25 + 6.5 = 31.5, or 29.2% of gross income. We then obtain the rate of return on productive capital, 31.5/250 = 12.6% for the gross yield, and

25/250 = 10% for the net return. Assuming that net investment in real estate capital is 2% of this capital, it amounts in absolute value to 3 (net), which gives a gross investment of 4.5. We deduce that investment in productive capital is 21.5 gross (26 - 4.5), i.e. 15 net (21.5 - 6.5). The rate of investment for productive capital is 19.9% gross and 15% net.

The period that began in 1980 is characterized by very different data. If we stay rather towards the end of the period, assuming a β ratio equal to 6, this gives a total capital K equal to 600 for a net income of 100, which is again consistent with Piketty's data. Always maintaining the same rate of depreciation ∂, i.e. 2%, capital depreciation ∂K equals 12. But the domestic investment rate has dropped by 4 points, and represents only 20% of gross income Y_g, itself equal to 112, which means an overall gross investment ΔK of 22, and an overall net investment I = dK amounting to 10. We take into account the existence of a housing bubble, which has increased the market price of property much faster than the general price level, which is why it now represents half of total wealth, i.e. 300 out of 600. This has reduced somewhat the performance of real estate capital, which explains that net rents are only 8 or 8% of net income. This gives us a lower rate of return on real estate capital, equal to 2.7%. If the rate of depreciation of real estate capital is still 1%, the gross rate of return is 3.7% and the depreciation in absolute value is 3.

By isolating again the productive capital, its depreciation is by difference: 12 - 3 = 9. The rate of depreciation of productive capital has risen to 9/300, or 3.0%, a slight increase, which is logical in a phase characterized by a slowing rate of accumulation. Let us assume that net capital income is now 37, which reflects the observed increase in the share of capital income. These are divided into 8 of net rents and 29 of net profits from productive capital. We deduce that the gross revenues of capital amount to 49, i.e. 11 of rents (8 + 3) and 38 of gross profits of productive capital (29 + 9). The rates of return on total capital are thus 8.2% for the gross yield (49/600) and 6.2% for the net return (37/600). The ratio between a gross capital income of 49 and a gross income of 112 is 43.8%. This corresponds for productive capital to a ratio of 33.9% (38/112) between gross profits and gross income. For rents the ratio is 9.8%. Finally, we obtain the rate of return on productive capital, or 12.7% for the gross yield (38/300) and 9.7% for the net yield (29/300). If net investment in real estate capital represents 2% of this capital, it amounts to 6 (net), with a gross investment of 9. We deduce that the investment in productive capital amounts to 13 (22 - 9) for gross investment and 4 for net investment I (13 - 9). It has declined by 39.5% for gross investment, passing from 21.5 to 13, and by 73% for net investment, falling from 15 to 4.

To sum up, we note that the leading factors behind the notable changes that have taken place from one period to the other are first a well-documented and sizeable increase in the share of profits, which can be linked to the change in the mode of regulation of the economies of developed countries. However this increase has not translated into a rise, but on the contrary, into a strong fall in the investment rate, although there has not been any reduction in the rate of profit! This fall is the second leading factor, because when it is prolonged over many years, a depressed level of investment is largely sufficient in itself to be the source of and explain the concomitant fall in productivity and the growth rate. But other findings of the model need also to be emphasized.

3.3 The main findings from the model

We can draw several findings from this stylized description, the first one relating to consumption, the second one to the evolution of β, the intensity of capital.

As regards **consumption**, for the first period we observe that the balance between all the profits (gross or net) and investment (gross or net) necessarily represent the share of consumption of the owners of total capital in total income, i.e. a net amount of 30 - 18 = 12, or 12% of net income. This is 14.6% of total consumption, which is equal to 82 (100 - 18). For the second period, in the absence of outward flight, the same balance between total capital income (gross or net) and total investment (gross or net) which represents the share of consumption of the owners of capital in total income, becomes 37 - 10 = 27, or 27% of net income! It is also 30% of total consumption, which is now, at the end of the period, equal to 90 (100 - 10), due to the fall of net investment. As for the consumption of the owners of productive capital in total income, its absolute value is 29 - 4 = 25, or 25% of net income! This is also 27.8% of total consumption. In

both cases this share has approximately doubled, and there is therefore no need to wonder why consumption from the workers stays at depressed levels.

We can also note that in the second period consumption accounts for 66% (or 25/38) of gross profits and that gross investment in productive capital, which is equal to 13 (i.e. 9 + 4) represents therefore only 34%, i.e. a minority share of these profits!

As regards **the intensity of capital**, we observe that the capital stock increases by 4.5% per year (18/400) during the first period, but that this splits into an increase of 2% per year (3/150) for real estate capital and 6% per year (15/250) for productive capital. This thus highlights the true mechanism by which the capital/output ratio β increases: the rate of growth of productive capital stock (6% per year) is higher than the growth rate of the economy, supposed to be 5% for this first period. If population increases by 1% per year, the growth rate of labor productivity is 4% per year. As for the second period, we find that the stock of capital increases only by 1.7% per year (10/600), but this involves an increase of 2% per year (6/300) for real estate capital, partly explained by the rise in real estate prices due to a bubble, and 1.3% per year (4/300) for productive capital. It is thus found that there is no reason for the β ratio to continue to increase: the growth rate of the productive capital stock (1.3% per year) is indeed lower than the growth rate of the economy, supposed to be 2% on average for the second period. If population continues to increase at the same rate of 1% per year, it follows that the growth rate of labor productivity has fallen to 1% per year.

3.4 The impact of globalization must not be overlooked

Both the above findings, about consumption and about capital intensity, have to be put into a wider perspective, because they do not take into account a phenomenon that has become more and more important since 1980, and especially since the 1990s. This phenomenon is globalization and in particular the steep increase of direct investment abroad. For France, outward FDI had shown an annual average of 4% of GDP, or about 4.5% of net income, between 1990 and 2011. But Piketty shows little interest for this phenomenon, as he is focused rather on foreign investments in developed countries, especially those related to the use of oil revenues by sovereign funds.

To be sure, this latter phenomenon is real, but it has not had the same magnitude as outward investment: again for France, inward FDI accounted for only half of outward FDI, averaging 2% of GDP for the period 1990-2011. The result is that part of the investment made in France during the same period was from foreign sources, representing approximately 15% of the average gross investment in productive capital. By contrast, over the past 35 years, French firms, or more precisely, the large internationalized French firms, have accumulated a capital stock abroad (in China and elsewhere) that could now approach 100% of French GDP, nearly a third of the domestic stock of productive capital. The amounts invested have certainly been reduced by the depreciation of capital, but increased by additional investments from locally generated profits. These profits are a priori much higher than in France or in any other developed country, since they are realized on the basis of wage levels that are most often barely one quarter or one fifth, or even less, of the corresponding French wages. It is true that there are other costs involved in investing abroad, but it is most probable that these investments would not have been made, had these profits been lower.

In any case, this implies that the growth of investment abroad is necessarily associated with an increase in the consumption of the owners of capital which is smaller than previously indicated. To take the last example developed above, this consumption is in fact reduced by a similar extent by the foreign investment of profits. If one applies an outward FDI of 4% of GDP to this example, consumption from profits in absolute terms falls from 25 to 20.5, and in percentage from 27.8 to 22.8% of total consumption. But for gross profits on productive capital of 38, consumption still accounts for more than half, or 54% of their amount. This is still good enough to explain the rise over the last thirty years of the consumption of luxury goods. This phenomenon of an increasing consumption, relative to profits, by the owners of capital, must obviously be related to the increasing inequalities, well highlighted by Piketty, but it is unfortunately not the subject of a thorough analysis in his book.

Yet it is a fundamental phenomenon, since it implies that while for firms reproduction and hence investment remain clearly the ultimate goal, things are not at all the same for households who own this

productive capital, and for whom it is indeed consumption, and especially the consumption of luxury goods, which is the main goal. As such, the increasing "financialization" of capitalism and the rise in the share of dividends in total income are going in the direction of this increasing consumption of profits. Although Piketty is not implicated with that, let us observe that this finding is sufficient in itself to invalidate radically the so called "Schmidt theorem", according to which "the profits of today are tomorrow's investments, which are the jobs of after tomorrow."

3.5 The fall in the growth rate g is reversible

Referring to the figures of the model analyzed for the first period (reconstruction), but limiting ourselves to productive capital only, we observe that the average "productivity" of capital (Y/K) is 100/250, i.e. 0.4. For production to increase from 100 to 105 (meaning a 5% rate of growth), with a remaining capital of 243.5 (6.5 corresponding to depreciation are removed from the production process) and an additional investment of 21.5, it is necessary that the new capital, incorporating innovations, has an average productivity equal to [105 - (243.5 x 0.4)] / 21.5 = 0.35. This is 12.5% lower than the productivity of the initial capital stock! This paradox is only an illustration of the law of diminishing returns (since the capital stock is growing faster than output), and shows that this law is not incompatible with the rapid growth of output. With the parameters of this example, we need only a little over 19 years for the β ratio to rise from 2.5 to 3, with an output that stands then at 255 and a stock of capital that goes to 765.

As for the model corresponding to the second period, after 1980, the average "productivity" of productive capital is then 100/300 or 0.33. To get a production of 102 (meaning a 2% growth rate), with a remaining capital of 291 (obsolete capital or capital withdrawn from the production process is 9) and an additional investment of 13 (9 + 4), it is required that the new capital, that incorporates innovations, has an average "productivity" equal to [102 - (291 x 0.33)] / 13 = 0.38. It is thus sufficient that the average "productivity" of the new capital be 15% higher than the average productivity of the capital stock, to compensate for a growth of the capital stock which is lower (1.3%) than that of output (2%). Let us agree that such an increase is quite easy to achieve with a minimum of technical progress!

In reality, there is every reason to believe that newly invested capital has a significantly higher "productivity" than the one which it replaces. The real problem is therefore that of the volume of capital and consequently of investment. What has been missing for 30 years and more in developed economies, is the investments at home, which have instead been made by their own firms in countries with low labor costs. They have concerned first the manufacturing sector, where labor productivity is the highest, leading to the de-industrialization of developed countries, and the accelerating growth of China, where more than half of exports and a significant part of growth are to be recorded on account of foreign investment. Putting Germany aside, these developed economies have been transformed into economies increasingly focused on services, while, as Piketty rightly points out, productivity is lower in services than in manufacturing.

It is however easy to show that not much would be needed for these economies to go back to higher growth rates. Starting from the above figures for the second period, let us suppose indeed that capitalist consumption would decrease by 6 percentage points (from 25 to 19 % of a net income Y of 100), and be replaced by a similar amount of investment in productive capital. This – compared to the figures of this second period, would make gross investment rise from 13 to 19% of net income. If this new investment had a "productivity" of 0.38, then new income would become Y = 291 x 0.33 + 19 x 0.38 = 104.2, meaning that the growth rate would more than double, from 2 to 4.2%, with a growth rate of investment still no more than 3.3% (10/300). With a labor force still growing by 1% and assuming a decrease by 1% in the unemployment rate, labor productivity would raise from 1% to 2.2%, which shows in passing that even the fall in labor productivity is not irreversible: increased investment, to the extent that it incorporates innovation, is indeed the key to increased labor-productivity.

However, for a given share of capital income, a rise in investment at the expense of capitalist consumption would simultaneously depress demand, which shows that such an assumption in the above paragraph was from this point of view incomplete! It would indeed be foolish to imagine that such a rise in investment might ever take place with a constant demand due to an unchanged labor share in global

income. It follows that an increase in workers consumption, and hence in their share of income, is a prerequisite for higher investment levels, and that only such an increase would be able to restart the engine of growth! In the above example, a 2.2% increase in labor share would indeed be enough to achieve an increase from 2 to 4.2% in the growth rate, and to trigger the rise in investment! After more than thirty years of reduction in this share, in accordance with the prescription of the neo-liberal model of regulation, we can thus better understand why this model has failed completely, in terms of its capacity to generate growth and employment, without even referring to the global financial crisis that erupted in 2008.

4. Conclusions

Several conclusions emerge from this analysis.

4.1 **The first conclusion** is that the amalgam made by Piketty between real estate capital and productive capital contributes to obscuring the vision of what has happened since the Second World War in the economies of major developed countries. Our model shows indeed a big difference in yields between the two types of capital, which goes nearly from one to three, from 4.3% to 12.6% during the first period, and from 3.7% to 12.7% in the second one. This reflects the heterogeneity of the mechanisms at work in both cases, which derive from the balance of power amongst households between landlords and tenants in the first case, and the balance of power between firms and workers in the second case. When taking into account total wealth as Piketty does, there is in effect between the two periods a small decrease in net return on capital, as he also indicates. But this decrease is primarily related to the lower performance of real estate capital, and corresponds to a virtually stable performance for productive capital, which shows a very slight increase in gross terms and a slight decrease in net terms.

4.2 **The second conclusion** is that, contrary to the qualms of Piketty, there is no inevitability of the continuation of an increase in capital stock at a faster pace than income, and therefore in the share α of capital income in total income. In contrast, in most developed economies the accumulation of productive capital has seriously slowed. Due to depressed demand, and also in part because of globalization and the rise in investment abroad, it has fallen to levels of investment going just slightly beyond the mere replacement of depreciated capital. In these economies there is even a tendency towards a relative decline in the domestic capital stock and therefore a decline in the β ratio, which, if r were truly constant, would even go in a direction opposite to that of an increase in the share of capital in total income α.

4.3 **The third conclusion** is that there is no inevitability either of stagnation, no offense to Larry Summers and his theory of secular stagnation of capitalism, or of a growth rate durably slowed down, no offense to Piketty. We have shown indeed that the growth rate of GDP can return to higher levels, as long as investment goes back to higher levels. Consequently the decline in labor productivity in the most developed economies, which stems first and foremost from lower volumes of investment, could also be reversed: there is no reason why investment would have lost its ability to increase labor productivity, in favor of which it acts as a powerful catalyst.

4.4 **The fourth conclusion** refers to Piketty's status as an economist. It is clear that he is a brilliant statistician and a great tax expert, and his book is a landmark in the field of wealth distribution, inequalities, and their evolution over time. However all his theory boils down to three simple laws, which transform the rate of return and the capital stock into almost intangible primary data, from which can only arise a decline in the labor share of income and a rise in inequalities. But this paper has shown that such laws have only a very limited explanatory capacity, because one of them is only a tautology (first law), while the validity of the other two is highly questionable. The flaws that we have exposed, and in particular the fact that these three laws do not pass the test of coherence, show that Piketty is not a theorist. In fact there is no proper economic theory in his otherwise excellent book, maybe because he did not want to distance himself from mainstream economic theory, which might have caused outright rejection of his theses. Thus, it turns out that national accounts and three simplistic laws cannot be a

substitute for a coherent economic theory. They cannot overcome the failure of neo-liberal or neo-classical theory, which stays at the basis of Piketty's theory of capital.

Although Piketty clearly does not accept the rise in inequalities, it is unfortunate that he seems nevertheless to accept the situation behind this rise, and the slowdown in growth and mass unemployment which results from it. To reduce inequalities, he only proposes an intervention through the introduction of a progressive tax on capital. It is therefore an ex-post action, once the distribution of wealth between capital and labor has been realized, and therefore without questioning this distribution at the level of the constitution of primary income. This position stems obviously from the simplistic theoretical content of his book.

4.5 **The fifth conclusion** is that there is a way out. To break the vicious circle in which the neo-liberal model of regulation has engulfed most developed economies, particularly in the European Union, and especially in the euro area, it is necessary to reverse the source of the demonstration. We should return to the message of Keynes and remember that the key to output growth and labor productivity is investment, which must increase as a share of global income. This does not require an increase in profits, since it can simply result from a decrease in the consumption of the owners of capital, translating into a higher share of investment in GDP, and deriving from a higher share for labor income and workers consumption.

The restarting of investment can certainly be implemented by governments (this is what Roosevelt did in 1934), but in a market economy to restart investment implies a growth in demand that can only come from increased real wages, and thus a distribution between capital and labor that is significantly rebalanced in favor of workers, after 35 years of an evolution that has been to their detriment. On the contrary an increase in capitalist consumption would not help, since it would at the same time reduce savings and investment, and depress global demand, as observed during this same period with the dismal results that everybody can well note. Furthermore, restarting domestic investment certainly implies also an increased control over investments abroad by firms in the most developed countries, which would of course depart from the neo-liberal dogma.

4.6 Finally, the overall conclusion of this article is that Piketty strives to show in his book that the reduction in the rate of growth of developed economies (the fundamental "force of divergence") has been the main cause of the rise in inequalities. The essential message of this article is that Piketty's demonstration is wrong and that on the contrary it is the rise in inequalities, through the rise in capitalist consumption and the fall in investment it has generated, which has been the main cause of the fall in the rate of growth.

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Climate Change, Procrastination and Asymmetric Power

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Abstract

This paper argues that policy conclusions of the economics of climate change literature based on "integrated assessment models" (IAM) fails to take into account the intricacies of collective action. Specifically, IAMs do not account for how asymmetric power between developed and undeveloped countries changes the former's pay off matrix with respect to mitigation and adaptation strategies. Using a simple one-sided prisoner's dilemma model, the paper illustrates how developed countries' power to externalize their emissions to the global commons skews their cost-benefit calculation in favor of putting off mitigation efforts into the future. Undeveloped countries on the other hand are incentivized to act in concert to deter developed countries from passing their climate costs onto them in the present. The extent to which they may succeed in doing so also helps developed countries overcome their short-termism on climate change policy.

Keywords: climate change, collective action, asymmetric power

Introduction[2]

The current ongoing debate on what to do about anthropogenic climate change boils down to two essential options, *mitigation* or *adaptation*. Mitigation involves an attempt to avoid climate change all together by limiting greenhouse gas (GHG) output now. Adaptation involves putting off dealing with the impacts of climate change into the future. Adaptation is a strategy of incurring costs in the long term while mitigation is a strategy of incurring them much sooner.

A curious divergence of opinion has developed between climatologists and economists on the preferred course of action with respect to these two policy options in recent years. While the weight of opinion among the former has decisively shifted towards mitigation, economists continued to favor adaptation, arguing that the costs of trying to mitigate climate change right away might exceed its benefits.

Economists' arguments derive from cost-benefit analyses based on models that specify what policy is optimal. These models are often criticized for the unreliability of their assumptions, for understating costs and risk of adverse climatic responses to warming while being overly sanguine about the ability of human societies to adapt to future impacts of climate change. More importantly, they are also criticized for ignoring the uncertainty about the possibility of an ecological catastrophe, the risk of which increasingly worry climatologists. While we agree with these criticisms and point to the conceptual limitations of the type of cost-benefit analyses they undertake as others have done (Tol *et al*. 2003, Stern 2007, Akerman *et al* 2009, Ackerman & Stanton 2013, Pyndyck 2013), our criticism takes a rather different tack. We argue that economists' models and policy conclusions ignore the intricacies of collective action. While perfunctory references to the "tragedy of the commons" and "free-riding problem" are commonplace in this literature, there is little recognition how costs distributed across agents with asymmetric power can distort cost-benefit calculus and change what policy option is "optimal". In addition to having important policy implications, this also matters for the discourse on climate change policy, since economists often make the heroic assumption that societies, just like individuals, would do what is optimal if they are "rational".

Most studies consider whether or not a strategy of mitigation or adaptation is in the best interest of an individual country or a group of countries in a region. Whether or not collective action is achieved in favor of pursuing a global policy of mitigation depends on a critical mass of countries or regions finding such a

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policy to have a clear cost-benefit interest for them individually. Often, this is where the analysis ends. But, of course, what policy is optimal for an individual country depends very much on what others do, and thus the argument becomes circular when we try to determine the collective outcome by summing up individual decisions.

Adaptation involves the emitter distributing its GHG emissions into the global commons, externalizing them onto all countries and regions regardless of their own emissions and level of vulnerability. Mitigation, by contrast, entails the emitter internalizing the costs it emits within its economy. Two general implications follow from this. One, because costs of mitigation are incurred individually while its benefits accrue to all, adaptation enables its pursuers to free-ride on those who mitigate. Given this intrinsic free-rider problem, mitigation requires extensive if not full cooperation and is thus hard to achieve, making adaptation the default outcome. Two, mutual defection from cooperation, i.e., all around adaptation which involves distributing costs to the global commons by all, amounts to passing on costs from high to low emitters.

Given the strong correlation between the rate of emission and the level of economic activity, low emitters are generally poor and high emitters the rich countries. Poor countries also tend to be located in regions more vulnerable to climate change, which also lowers their bargaining power over global policy on climate change. Asymmetric power between the rich and the poor enables high emitters to shift costs onto the low emitters with relative impunity, and that makes "kicking the can down the road" tempting for developed countries, undercutting their interest in forging a harder to achieve but in the long run superior, coordinated solution mitigation requires. But, procrastination could lose much of its appeal had the emitters lacked the power to pass on costs with impunity. If all adversely affected powerless actors could act in unison to deter cost shifting by the emitters that could potentially make mitigation the preferred policy for the powerful players. In other words, the power balancing effect of such a coalition could be the very impetus for overcoming short-termism and acting in their long term enlightened self-interest. This implies that in evaluating different policy options an important consideration should be whether they help or hinder coalition building on the part of the powerless actors.

The rest of the paper is organized as follows. In Sections I and II, we give a brief overview of the positions taken, respectively, by economists and climatologists on climate change. In Section III and IV, we situate the climate change policy debate in the context of a clash between short-term and long term objectives, and go on to argue in Sections V the link between asymmetric power and short termism on the part of developed countries. We emphasize the importance of power balancing by undeveloped countries through coalition building in overcoming short termism, and point to the policy implications of our argument. We end with a brief conclusion.

1. The economics literature on climate change

Economic studies of climate change impact began in the late 1980s and early 1990s (Cline 1992, Nordhaus 1991, 1992). Many of these studies looked at a single country like the US, asking what would be the impact of a doubling of pre-industrial level of atmospheric CO_2 concentration (560 ppm) on sectors of the economy most dependent on nature such as agriculture. Since agriculture makes up only about 2 to 3% of the US and most other OECD countries' GDP (Tol *et al* 2003) and other vulnerable sectors make similarly a small relative contribution, these initial estimates of the economic impact of global warming were small. When these country specific studies were aggregated to the rest of the world the global impact was likewise found to be relatively insignificant as well.[3] This first generation of impact assessment models estimated about a 1.5 to 2 percent cost in terms of global GDP for a doubling of pre-industrial CO_2 concentration with associated levels of warming in the range of 2.5c (Tol *et al* 2003).[4] Clearly, none of these studies lent support to a policy of mitigation as they seemed to suggest that waiting to mitigate greenhouse gas emissions (implicitly choosing an adaptation policy) involved relatively modest costs.

[3] See, for instance, Nordhaus' (1992) DICE model.
[4] In these models, the warming levels assumed from given increases in CO_2 concentration is rather optimistic in comparison to the IPCC (2007) estimates.

However, most developing countries derive a much higher relative share of their GDP from agriculture, often in excess of 50%, than do OECD countries, and thus using the US or Europe's agricultural impact as a baseline for these countries grossly underestimated the impact of climate change on developing countries (Nordhaus & Yang 1996, Tol *et al* 2003). The problem was addressed by regionally calibrating the impact assessment models (Nordhaus & Yang 1996, Mendelsohn & Schlesinger 1999, Mendelsohn *et al* 2006). These so-called the "integrated assessment models" (IAMs), showed that different regions in the world would be affected very differently by climate change especially in the initial phase of global warming. Out of this literature came the "hill shaped" response function to climate change (Mendelsohn *et al* 2006). According to this, the impact of rising temperature is initially positive on a *cool* region's economy and becomes negative only past a certain threshold after the region's climate becomes too warm. The regions that are already warm in lower latitudes in many parts of Africa and Southeast Asia with limited ability to protect coastal areas are the most vulnerable (Mendelsohn *et al* 2006). By contrast, warming is expected to move other regions such as Russia, Canada, some parts of the US and Europe, initially to a temperature level that might be economically beneficial (Mendelsohn *et al* 2006).

These findings implied that developed regions had less of an incentive to opt for corrective action early on than undeveloped and regionally vulnerable areas. The latter faced not only immediate costs but also the prospect that these costs could cumulate to debilitating and possibly catastrophic levels by the time developed countries ceased externalizing costs to the commons. Yet, factoring in undeveloped countries' losses did not tip the scales much in a "global" cost-benefit analysis,[5] because relatively small gains in a country like the US more than offset the economic devastation in smaller undeveloped countries in the aggregate because of the smaller size of their economies.[6] Thus, delaying mitigation could be shown to involve a net benefit until warming reached higher levels. This led to the notion that there was some "optimal" level of warming.

Nordhaus (2010) specifies what this optimal level might be and compares it against several different climate scenarios. He starts out by calibrating a worst-case baseline scenario, involving a situation where no action is taken by world governments with emission growth proceeding unchecked. Atmospheric CO_2 concentrations reach 795 ppm by 2100 and top 1200 ppm by 2200. Warming from such levels of CO_2 is estimated to reach 3.5c by 2100, eventually peaking at a 6.7c increase relative to 1900 temperatures. It is uniformly accepted that such levels of warming would most likely involve an ecological disaster (IPCC 2007).

Nordhaus' "optimal" scenario, an example of what an "adaptation" strategy might look like, involves the reduction of CO_2 emission level to 50% of its 2005 level by 2100, where warming peaks at 3c increase with atmospheric concentration rising to 600 ppm.[7] Comparing the optimal with the baseline scenario, he estimates that the former yields a higher level of global consumption by 8.06 trillion in 2005 USD, a 0.35% improvement of discounted income over the baseline scenario. He then compares the optimal (adaptation) scenario with, what might be called mitigation, defined as maintaining a 2c ceiling on warming by taking more immediate action which the climate science community has been advocating (more on this below). He calls this the "temperature limited" case and estimates that it requires again roughly a 50% cut in emissions from their 2005 levels, but much sooner, by 2075. Now, CO_2 concentration rises to 500 ppm by mid-century and eventually stabilizes at 450 ppm. This case also fares significantly better than the worst-case baseline scenario, yielding a 4.37 trillion worth of higher, a 0.19% increase in discounted, consumption, but falls short of the optimal case roughly by half.

This is perhaps the clearest statement of the basis on which economists believe that developed countries can reap a net benefit from delaying mitigation. They oppose trying to limit warming to 2c or less, since that becomes very costly "because of the difficulty of attaining that target with so much inertia in the

[5] Note that these models made the implicit assumption that the marginal utility of consumption in poor countries is the same as that in rich countries. Known as "Negishi-weighing," this assumption basically amounts to ruling out of consideration any improvement in global welfare through income redistribution (Stanton 2009). We thank Tariq Banuri for pointing this out.

[6] These estimates from the 1990s predate the explosive economic growth of China and India. In Nordhaus & Yang (1996) India is part of "the rest of the world" while China is mentioned only in passing. Today, China is the second largest national economy and the largest emitter of CO_2 in the world. Reaching any global climate targets today would require both China and India to mitigate along with developed countries.

[7] These estimates are again on the optimistic side of the spectrum as they leave out land use changes and greenhouse gases other than CO_2, and assume the lower bound of probable warming from a 600 ppm concentration. IPCC (2007, p. 66) estimates that warming from the same level of CO_2 concentration (600ppm) can be as high as 6c.

climate system" (Nordhaus 2010). The intriguing question is whether economists might be peddling "fool's gold"? At the risk of sounding alarmist, climatologists think that delaying mitigation is basically tantamount to playing Russian-roulette with the planet's very survival. For them the notion that one part of the planet can benefit from warming while the other part is devastated is not only misguided but also a dangerous illusion (Stern 2007).

2. Climatologists

When looked at from the point of view of climate science the picture is grim. Climate scientists warn that humanity is risking leaving behind the very climatological epoch – the Holocene era of the last 12,000 years – that gave it agriculture, science and industry (Hansen *et al* 2008). Their main concern is that warming can trigger a nonlinear reaction that takes the planet to a fundamentally different climate system where warming intensifies independently of what humans do. If that were to happen, any mitigation effort at that point would be too late.

With global temperature at its warmest level in the Holocene, little additional climate forcing from GHG emissions and land use changes are required to trigger positive feedbacks. Rapid melting of land ice as recently observed in Greenland[8] is an example of the kinds of changes that can give rise to the feared positive feedback effects given that ice reflects 90% of the solar radiation hitting it whereas water and land absorb nearly all of it. Among others, the rising CO_2 content of the deep oceans and surface Albedo can also trigger positive feedback effects. If these show up earlier than expected, as is now seen more likely than before, warming can proceed even without any additional forcing. Climate change would then be locked in a trajectory of automatic warming that could be next to impossible to mitigate. This is what climatologists are becoming increasingly concerned about (Stern 2007, Hansen 2008, IPCC 2007 & 2014).

No one knows with any precision at what point that might happen. Yet, there is little doubt that these tipping points are real, and that makes the situation alarming. In previous periods of higher CO_2 ppm atmospheric concentrations and higher temperature the speed at which CO_2 ppm increased was approximately 0.01 ppm per year. Now, humans are increasing it by 2ppm per year (Hansen *et al* 2011). Never before in Earth's known history has so much CO_2 been added to the atmosphere from year to year. It is possible that warming up to the economically "optimal" level of 3c might entail crossing some tipping points. Of course, building in additional warming beyond 3c will only increase the risk of passing that critical threshold beyond which mitigation becomes much more costly, if at all possible.

Because crossing tipping points can have such grave consequences, climatologists call for immediate action to prevent them from happening at all cost (Stern 2007, Hansen *et al* 2008, 2011, Hansen 2008, IPCC 2007, 2014). In their view, the current CO_2 ppm concentration of 400 ppm is already too high. Even if such tipping points are not crossed, warming risks causing irreparable damage to the ecosystem as it is. The northerly migration of plant and animal zones that has already been taking place is an alarming sign. Given that humanity relies on the ecosystem for its survival, pushing it to its breaking point threatens not only polar bears but also the civilization itself (Hansen 2008).[9] Minimizing the risk we face requires that climate change is limited to 2c, and that means CO_2 concentration should not be allowed to exceed 350 ppm. Thus, staying in the "safe" range requires immediate action, which the most recent 2014 IPCC again calls for with even direr warnings than in 2007.

However, while there might be little uncertainty that climate change is happening, climate science still lacks precision on many questions: how much and fast warming will occur, how sensitive the climate will be to rising CO_2 levels, land use changes and other greenhouse gases; and how will the Earth change climatically and physically at rising levels of warming, among others. Thus, cost estimates unsurprisingly remain far from robust and fail to converge over time. In fact, the very danger of an ecological disaster and the uncertainty it creates brings into question the very viability of the exercise. If future contingent outcomes

[8] In the summer of 2012 the melting in Greenland ice sheet in just 4 days jumped from 40% to 97% melting: http://www.nasa.gov/topics/earth/features/greenland-melt.html

[9] As Daly (1997) and other ecological economists have argued for a long time it is important not to lose sight of the fact that the economic system resides within the larger ecosystem.

cannot even be specified given the level of uncertainty, cost estimates end up becoming arbitrary as slight variations in what contingent scenarios unfold produce drastically different results.[10] How does one quantify the increased extinction risk of a given percentage of species and estimate its implications for the ecosystem over time?

3. Changing preferences and procrastination

Economists engage in considerable cherry picking in their cost benefit analyses, but otherwise their assumptions are based on climate science albeit with a time lag. As climate scientists' forecasts become more pessimistic over time, economists are soon likely to revise their optimistic assumptions at least on issues related to hard science. One exception that appears impervious to changing opinion within climate science involves *discounting*, a putative forte of economists.

With a given set of science based assumptions, the balance between present value of long-run costs and benefits from growth can vary drastically depending on what discount rate one uses.[11] Economists postulate of a *pure* discount rate on the presumption that a time-invariant time preference of consumption exists for humanity as a whole.[12] This rate supposedly captures our inborn impatience that makes us prefer consumption today over consumption tomorrow. A higher discount rate values current consumption more heavily relative to future consumption in general, and, holding all else constant, makes mitigation less desirable given that future costs then weigh relatively less today.

We believe that economists can make a better contribution to the debate on climate change if they focus on how behavior might be affected when preferences evolve over time rather than postulating an invariant discount rate that seem unconvincing. Defining our relative preference for immediate consumption independently of what we think of how our actions today might influence the future might be of doubtful value. Given that our preferences are all mediated by some form of cognition[13] (Bowles 1998), it is only reasonable to think that they would change when our understanding of how what we do today affects what happens in the future changes. Thus, the notion that as humanity absorbs the findings of climate science regarding the risks associated with delayed action on climate change its *pure* discount rate would militate against taking action sooner than later lacks purchase.

Take changing views on smoking as one example of how our preferences change when our notion of the future consequences of our actions today changes. Few today doubt that smoking is harmful including those who continue to smoke (CPPE 2011). Once the future consequences of our actions are better understood, our subjective evaluation of costs today versus costs tomorrow also changes. The more pertinent problem is that this might not translate into change in behavior readily. Often when our "long term" preferences change our actual behavior might not, at least for a considerable time, and this might be the more important issue for economists to focus on.

The smoking example also highlights this problem. We know only too well that many smokers who want to quit perpetually put off quitting. While they do not want to be smokers in the long run, they keep smoking in the present. As is the case with *procrastination* more generally, this involves a situation where the two sets of preferences, long and short term, are caught up in a perpetual clash. A smoker who knows that quitting is good for him/her might still dread the difficult adjustment cost it entails in the short run. Continuing to smoke (adaptation) involves rising future health costs and risks that can be alarming. But, these costs are mainly probabilistic, long run and thus discounted, while the cost of quitting (mitigation) is certain and all front-loaded. That can make the smoker's discount rate an important determinant of when (and if) s/he will quit. For instance, public health messages that warn teenagers about the future health risks of smoking often

[10] Most economics models neglect possible sudden impacts such as rapid ice melt off or sudden sea-level rise let alone an ecological catastrophe however defined (Roughgarden & Schneider 1999, Stern 2007, Akerman *et al* 2009, Pindyck 2013) See Weitzman 2011 for a broader discussion of deep structural uncertainty and "fat tails" in critical probability distributions in climate change research.
[11] See, Stern (2006), Nordhaus (2007) and Azar & Sterner (1996).
[12] The discount rate is thought to comprise a *pure* time-preference component and another part that reflects marginal utility of consumption that is expected to diminish with increasing levels of affluence (Arrrow et al 1995; Fankhauser 1994). Here our discussion focuses on the former.
[13] The exception being the subset of preferences that find expression in visceral reactions of the type, "I hate this, or love that".

fall on deaf ears because teenagers tend to discount the future very heavily.

We clearly do not consider teenagers' high discount rate an unchangeable inborn trait but a problem that needs correction, and when an adult discounts the future heavily we consider it a moral failing.[14] If we thought the *pure* discount rate was an immutable *given*, continuing to smoke for a time could then be shown to entail a net utility benefit. In fact, the higher a youngster's discount rate, i.e., the more "shortsighted" one is, the economists could conceivably advise smoking longer in the name of maximizing utility.

Counselling smoking teenagers not to be rash in quitting and arguing for delayed mitigation in climate change policy might share some similarities. True, in the case of smoking the relevant trade-off is between the well-being of the same person today *versus* tomorrow, whereas in the case of climate change it is between the well-being of future generations *versus* that of people who are alive now. But, in both cases the well-being of the future self or future generations are very much dependent on what the present self or generation do in the present, which suggests that what we want for the future and do in the present can clash in a similar manner.

4. Short-termism and climate change

Just as the typical teenager, the present generation can be said to have difficulty imagining a future that is fundamentally different than the present. That tends to shrink the very time horizon that defines the *long run*. Consider the different time horizons involved in how the future or "long-run" is conceptualized respectively by economists and climatologists. The long run equilibrium of climatologists might take as long as a thousand years to materialize. It is a state where the climate forcing effects of GHG emissions and land use changes have stabilized and there is no further endogenous warming or cooling. By contrast, for economists it is hard enough to trust any long run equilibrium model predicting 10 years out, let alone a hundred years.

This means that economists' long run models cannot possibly take into account the full long run cost of climate change from a level of GHG emissions that upsets the ecological long run equilibrium. The sea level in the new ecological equilibrium might rise, say, so much as to leave only the Andes and Himalayas dry, but if that takes one thousand years and we are only looking at next 100 years at a time, the cost of mitigation might remain higher than adaptation in much of the hundred year intervals before reaching ecological equilibrium. When finally adaptation becomes the more costly option, climate might no longer be responsive to mitigation. One is reminded of the story of the frog too lazy to get out of the warming pond under the rising sun, finding a way to adapt to the increasing heat every step of the way until it boils to death. Economists might have something useful to say on why that happens and how such short-termism (procrastination) can be overcome.

Akerlof's (1991) analysis of the dynamic inconsistency between short and long run preferences in procrastination gives an idea why the proverbial lazy frog procrastinates to death. With a decision horizon that is exceedingly short taking action now rather than later has a *salience cost*, giving rise to the inability - common to both the *lazy frog* and the *grasshopper* - to anticipate the future. If the cost of taking corrective action (say, quitting smoking) today is the same as tomorrow, both higher than its small short run benefit, the salience of the immediate cost in the current period makes it more "costly" than undertaking it in the next. Thus, taking action tomorrow ends up being always preferable to doing so today. Our short term preference is then caught up in a perpetual clash with our long-term preference.

In situations where we know this kind of a clash will occur we often devise practical schemes to safeguard our longer term preferences. Consider an example from Schelling (1984) with our twist on snoozing. Right before going to bed late at night we want to wake up early in the morning and not be late to work, but at the same time know quite well that come morning we will not want to get out of bed. In other words, we expect our long term preference to come into conflict with our short term preference in the

[14] The older generation of economists clearly have thought so. Similar to Aasop's fable with *the grasshopper and the ant*, Irving Fisher wrote, "Generally speaking, the greater the foresight, the less the impatience and *vice versa*.... This is illustrated by the story of the farmer who would never mind his leaking roof. When it rained he could not stop the leak, and when it did not rain there was no leak to be stopped! Among such persons, the preference for present gratification is powerful because their anticipation of the future is *weak*." (cited in Akerlof 1991, p. 6).

morning, and predict that we will keep pushing the snooze button only to end up rushing uncomfortably or be late. As we press the snooze button to silence the alarm clock for few minutes at a time our decision horizon is exceedingly short. At the end of the first snooze period, we decide to push the snooze button yet again because getting out of bed after the next snooze period is preferable to getting out now, and so it goes until we end up being late.

How do we deal with this problem? As Schelling remarks, one possible remedy is to put the alarm clock away from bed to make it harder to delay getting up. Once taking action cannot be delayed with ease the decision time horizon extends and the cost-benefit calculus then changes, and with it our myopic inability to anticipate the future is overcome. In more general terms, the moral is that dealing with procrastination involves finding a way to willfully constrain our freedom of choice/action in the short run such that it becomes easier to act on our long term preferences which we believe will make us better off (Schelling 1984, Akerlof 1991). In other words, when what appears "optimal" from a short run perspective is not so when looked at from a longer run perspective, constraints on our short run freedom of action to pursue what we desire to do might be in fact a blessing in disguise.[15]

What does this say about overcoming *collective* short-termism in climate change policy? At a cursory level, clashing long and short term preferences/interests in the realm of political decision making is also commonplace. Governments the world over find their policy agendas shaped by pressing short run political pressures that have urgent appeal for their constituencies, leaving little room to address long term concerns that have little salience even if they are exceedingly important. Usually, political reforms that tackle long term, structural problems become politically feasible only after a crisis.[16] Crises have this effect arguably because they reduce the relative salience of the short run by raising the public's attention on the long term issues and problems that need to be addressed. That, in turn, constrains the ease with which political power can elect to avoid taking steps that are politically costly in the short run. So, again, constraining short run freedom of choice (for inaction) makes it easier to serve long term objectives.

But, at a deeper more general level, arguments that generalize from individual behavior require closer scrutiny for they can run into two types of problems. One is fallacy of composition. What is true for the individual need not be so for the group as a whole. In the simple one-shot PD game, for instance, individuals acting on what is optimal for them produce in the aggregate a sub-optimal outcome. The other complication arises from the political and social determinants of collective agency. Even if social optimum could be specified by simply aggregating individual preferences (the first problem), the nature of social divisions between groups/classes and the *rules* of political contention among them might render it unachievable (the second problem).

It is not unusual for economists to ignore both problems – especially the second one which is often taken up if ever by non-Walrasian economists, old and new, on the fringes of the profession (Ertürk 2012). Broadly speaking we are inspired by this literature and draw on its insights to show in the next section how the consideration of a political/social variable (i.e., asymmetric power among countries/players) which bears on the second problem is integral to the outcome with respect to the first. The problem of *radical* uncertainty aside, cost benefit analysis on climate change is not purely a technical exercise as economists tend to assume. Political constraints can often prove decisive in altering what course of action is optimal for the powerful agents whose decision matters, and it turns out *procrastination* can indeed be a helpful analogy in discussing how collective short-termism can be overcome. Using simple game theory we show that the existence of asymmetric power is tantamount to the removal or absence of a short term constraint that could have potentially constrained developed countries' freedom of choice in favor of inaction in the ecological short run and helped them act on their long term interest. By implication, anything that changes the power imbalance can also alter what is *optimal*.

[15] In mythology, the story of "Dionysius (Ulysses) and the sirens" makes the very same point – see Elster (1977).
[16] Rahm Emmanuel's famous political dictum, "Never allow a crisis to go to waste. They are opportunities to do big things", captures this well. Quoted in Zeleny (2009).

5. Collective action, asymmetric power and climate change

The power asymmetry between the poor and rich countries is a pervasive, essential characteristic of the world economy that shapes their multi-faceted interaction, whether in the context of the global economy or the international political fora where terms of multilateral cooperation are typically negotiated. Yet, its ubiquitous nature and the complex, multi-faceted ways in which it manifests itself makes it hard to capture it in highly abstract, stylized economic models.

Here, we try to deal with this challenge by working with a simple, parsimonious definition of power asymmetry in simple game theoretic terms as to whether one's course of action has influence on the other players' payoff. The *powerless* can then be thought to face a one-dimensional prisoner's dilemma as what they do, defect or not, has no influence on the more powerful player's payoff. In our particular example, whether undeveloped countries choose mitigation (non-defection) or adaptation (defection) makes little difference to developed countries' wellbeing, and thus individually each developing country *vis a vis* developed countries as a group finds itself in a one-dimensional prisoner's dilemma. By contrast, when developed countries follow a policy of adaptation (defection), undeveloped countries are liable to suffer the ill-effects of warming regardless of what they themselves do.

Figure 1

	Developed Countries: Mitigation (non-defection)	Developed Countries: Adaptation (Defection)
Poor Countries	*Win* (1A) *Win*	*Win* + (1B) *Lose*

In Figure 1, in (1A) both regions benefit from mitigation, (first top entry is Column's payoff and the second below the Row's) while in (1B) developed countries get the superior *temptation payoff* from adaptation in contrast to the ***sucker's payoff*** the undeveloped countries receive. The disagreement between the economists and climatologists revolves around the question as to whether the temptation payoff (1B) is really preferable to (1A) for developed countries. In the shorter run perspective of the economists (1B) is superior to (1A), because developed countries can continue to benefit from growth at least for a time without paying an ecological price. Given their longer term perspective, the reverse holds true for climatologists.

According to the climatologists the likely outcome of adaptation in cell (1B) involves a *death spiral*. Warming rises beyond safe levels as powerful countries continue to externalize costs to the global commons. The vulnerable regions begin facing steeply rising ecological costs in the not too far-off future with prolonged droughts/floods, severe food shortages, both giving rise to heightened conflict over resources and an ever increasing exodus of environmental/war refugees. In the meantime, as developed countries continue adapting to warming some of the geophysical tipping points that accelerate warming are crossed. Warming settles on an unstable upward trajectory and the cost of mitigation proves inordinately higher than anticipated at the economically "optimal" level of warming.

What could prevent this ascent towards the *death spiral* the climatologists fear is of course the question. That is tantamount to asking, what would it take for the powerful countries to act on their enlightened long term self-interest and move from cell (1B) to (1A) in a timely manner? In our view, such a policy reorientation might entail a three step process. The first involves a sea change in long term preferences. Perhaps similar to how public attitudes towards smoking has evolved in the last few decades,

we are arguably in the midst of a similar global transformation with respect to public awareness about the threat global warming poses for the future of the planet. As public's awareness of the gravity of the threat extends, the second stage would be the growing recognition of the conflict between our short term propensity to postpone corrective action and the planet's long term wellbeing. This is the period of *procrastination* where the dynamic inconsistency between our short and long term preferences/interests results in the perpetual postponement of taking action. Finally, the third stage is when the conflict is resolved in favor of our long term objectives when constraints are placed on our short run freedom of choice for inaction.

Note that there is an essential asymmetry between (1B) and (1A) in terms of their respective implications with respect to collective action. All out adaptation in (1B) requires no cooperation and developed countries end up acting as a bloc (*vis-a-vis* undeveloped countries) by merely acting on their individual short term interest. By contrast, mutual mitigation in (1A) requires developed countries to agree on a mutually binding set of restraints on their behavior, and, for it to be effective, an ability to sanction defection among their midst.[17]

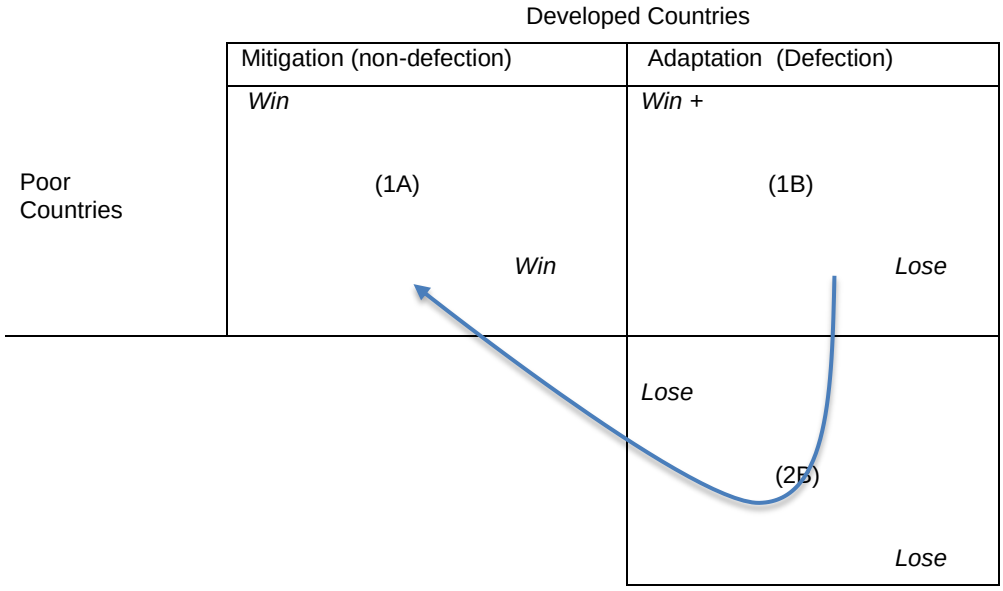
Returning briefly to our smoking example, the smoker who is trying to quit realizes that resisting smoking *today* is worthwhile only if s/he will be able to resist the temptation *tomorrow* as well. Otherwise, incurring the cost of not smoking *today* will be wasted effort. If the smoker had some credible reason to expect that some constraint will impede his/her freedom to backslide *tomorrow*, it becomes so much easier to *commit* to not smoking *today* (Schelling 2006). In a similar dynamic, any individual developed country that mitigates would incur costs in vain if other developed countries were to backslide on their commitment. Thus, in the absence of a constraint that can credibly be expected to impede backsliding by self and others it becomes hard to commit to mitigation by any individual developed country in the first place.

Given that they happen to be in regions that are not immediately vulnerable to warming, the developed countries' crucial *short run* freedom is their ability to externalize climate costs to the global commons. This is made possible mainly by asymmetric power, and thus the inability of undeveloped countries who are adversely affected in the present to deter it. It might be in the long term interest of developed countries not to externalize climate costs, but the fact that they can makes it hard for each of them individually to commit to mitigation. When one powerful agent gives up its freedom to individually benefit from the weakness of the weak agents for some collective benefit, it has to be confident that the other powerful agents will do so as well. Otherwise, self-restraint simply enables another to profit at one's expense. This is the *commitment problem* of the powerful, and its solution requires a *commitment device* that would enable an individual *powerful* agent to credibly expect others to follow suit when it self-restrains (Ertürk 2011).

But, if undeveloped countries were capable of changing the payoff matrix of developed countries through some concerted action, it could potentially work as a *commitment device* that would make it easier for developed countries to act in their long term interest. Stylistically, if a coalition of undeveloped countries could reduce the developed country payoff through some retaliatory action both group of countries would find themselves in (2B) in Figure 2. With (1B) no longer attainable, (1A) would then become the preferred option for developed countries not only in the long run but in the short run as well. Collective *defection* by undeveloped countries could in this instance perhaps refer to something much broader – an ability to speak in one voice on climate policy in international fora that energizes activists worldwide, raising political costs for developed countries in the home turf through *striking*, *boycotting* and public *shaming*.

[17] For instance, given the voluntary nature of the Kyoto Protocol there were no adverse repercussions when both Japan and Canada failed to meet their commitments made in it. That also brings up the question whether effective international obeisance can ever be achieved without active US involvement even though its willingness and even ability to exercise leadership is increasingly in doubt. Interestingly, there are some tentative signs that opinion on climate change might be beginning to change within the US political elite. A new study just released by the bi-partisan *Risky Business Project* (RBP 2014), and backed by former Treasury Secretaries Hank Paulson, Robert Rubin and George Shultz, examines the financial risks of global warming with an objective to transform how American businesses and politicians (do not) think about climate change.

Figure 2: Preventing the *Death Spiral*



To the extent growing awareness of financial and economic costs associated with extreme weather patterns (IPCC 2014)[18] and spillover effects of climate related calamities that are likely to begin unfolding in undeveloped countries in not a too distant future are transformed into *salient* politics at home it is conceivable that the developed country payoff can change. If continued adaptation is thereby made politically and economically more costly by a block of undeveloped countries acting in concert no individual developed country will be dissuaded from mitigation on account of fear of others' probable defection.

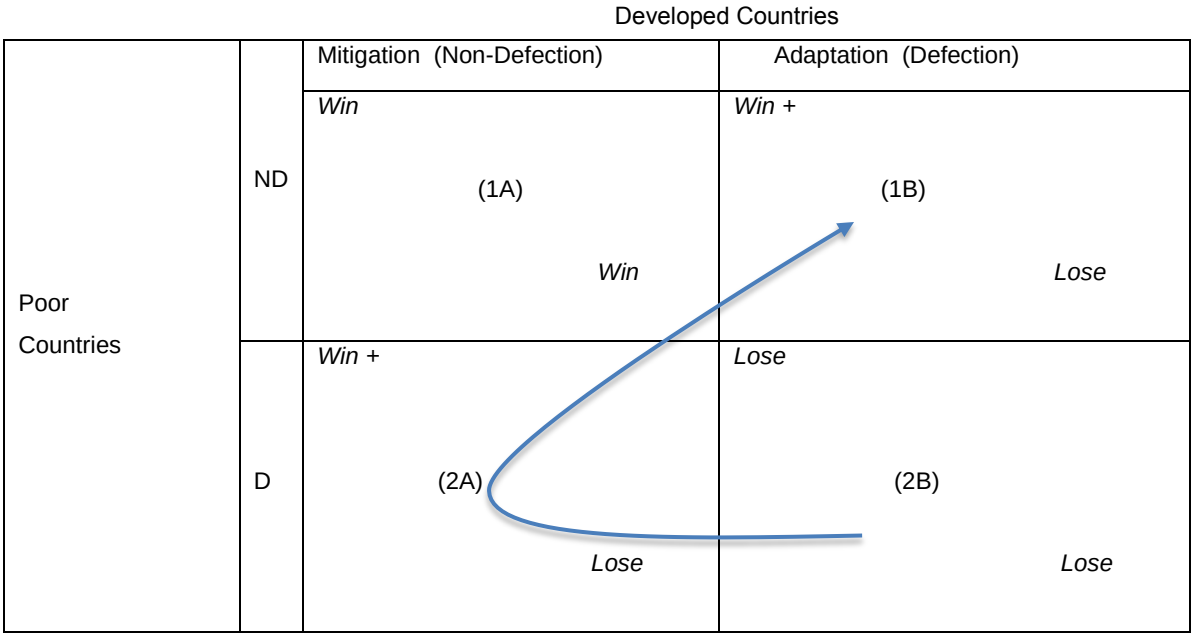
Clearly, whether undeveloped countries can at all act in concert, especially given that China and India might possibly favor delayed mitigation; and, if they did, what exact form would their *defection* take are questions not easy to answer. At this point we can only speculate. Though the comparison can be misleading, it is interesting to note that in the WTO's Doha trade talks undeveloped countries did manage to act in a block (Kleimann & Guinan 2011). Their collective ability to cause the collapse of the talks is an instance where they managed to reduce the developed country payoff to *mutual punishment* – (2B) in Figure 2 - which might yet prove to be the strategic prelude to the achievement of a more equitable accord based on cooperation (1A) in the long run.[19] Coalition building (and maintenance) requires that players are able to (i) coordinate behavior, (ii) monitor defection, and (iii) bring political pressure to bear on defectors. Individual members can thereby not only coordinate and identify norm breakers more easily, but also enforce rule obeisance within the group.[20]

There is also the possibility that developed countries can preempt or prevent any coalition building on the part of undeveloped countries by providing them incentives to break rank. That would cause them to compete among themselves for what we might call the "scab's payoff," (2A) in Figure 3, in the form of financial and economic favors from developed countries in exchange for hosting their ecologically costly activities and legitimating developed country actions and positions in international fora.[21] The effect would be

[18] See also a report by the British non-governmental organization, Carbon Tracking Initiative (CTI 2013).
[19] Climate policy is of course very different given that neither the terms nor the institutional framework of bargaining can yet be said to exist. Yet, future trade negotiations are likely to become increasingly enmeshed with environmental issues. Free trade agreements have been used on numerous occasions to dismantle environmental regulations at the local and national level (Klein 2014, page 69) and it is likely that they will continue to get in the way of efforts to address environmental concerns. On the other hand, while in principle trade sanctions can potentially be effective in controlling carbon emissions, it is also true that environmental issues can be used opportunistically to raise entry barriers for developing countries in advanced markets (Esty 2001).
[20] As a colleague who worked at the UN for long years put it, "when developing countries want something they try to have everything out in the open and when developed countries want something they work behind closed doors."
[21] See, O'Brein & Leichenko (2000) for an extended discussion on how the financial/economic and environmental vulnerabilities of undeveloped countries can interact to their detriment.

to keep most undeveloped countries locked in or return to (1B) in a one-dimensional prisoner dilemma. In fact, anything that lowers the ability of the powerless countries to form coalitions and deal with free riders in their midst will increase the probability of returning to the *death spiral*.

Figure 3: Back to the *Death Spiral*



6. Conclusion

We have argued that IAMs ignore how asymmetric power can skew the cost-benefit calculus of developed countries towards delaying mitigation. The distribution of climate costs around the globe is not just a geographic given, but also an attribute of asymmetric power. The freedom to externalize their emissions to the global commons makes it harder for developed countries to overcome short-termism, just as it incentivizes undeveloped countries to act in concert to deter the former from passing their climate costs onto them. Thus, to the extent undeveloped countries can succeed in coalition building and act in concert they can potentially help developed countries overcome short-termism and act in their enlightened long term interest as well.

Much of the policy discussion on climate change addresses the problem of controlling carbon emissions at a technical level, focusing narrowly on the instrument choice. Either emissions are to be capped at some level or the price of carbon is fixed through taxation. In the former approach quantity of carbon is fixed and its price varies with market demand, while in the latter price is fixed and quantity varies when demand changes. The implications of these two basic approaches are then discussed in terms of their relative advantages and shortcomings, without however any real clarity on what the relevant criteria are. The usual utilitarian rubric economists traditionally use in choosing between different policy options is hardly satisfactory at least when it comes to climate change. But, in the absence of an explicit discussion on an alternative it tends to slip back into the analysis by default. That in our view is a critical lacuna in this literature.

Thus, the emphasis on the instrument choice ends up obscuring the more central problem of stipulating the normative and political underpinnings of collective welfare and choice. Two salient facts about climate change policy complicates the possibility of a neat separation between *normative* and *positive* analysis, a separation that comes only natural to most economists. One, the policies that are taken (or not taken) today will have a decisive effect on the wellbeing of future generations, putting them possibly at peril;

and, two, their costs and benefits are distributed very unevenly across agents currently alive per their relative position of power. Our discussion shows that the "optimal" policy is not independent of the outcome of the interaction of agents with asymmetric power, which in turn depends on the success of the power balancing efforts of disadvantaged and powerless agents acting on the basis not only by self-interest but also the strength of their normative values.

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Data Visualization in *Capital in the 21st Century*

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Abstract

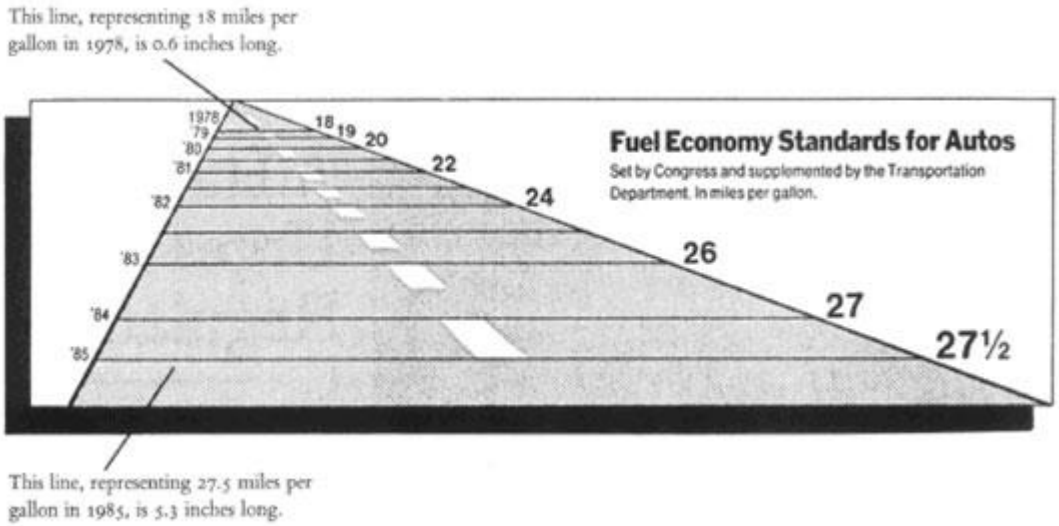
This paper examines how data visualization is used to supplement the arguments in Thomas Piketty's *Capital in the 21st Century*. Piketty shows a consistent pattern of modifying his visualizations to provide stronger support for his arguments than his data contains, particularly in his visualizations of the rate of return on capital as it compares to the rate of economic growth, one of the central arguments of the book. This modification takes the form of using disproportionate axis units and the addition of estimated or speculative context. The effect of this modification is to change the fundamental shape of the data trends, which can be clearly seen when proportional axes are used and hypothetical context removed.

The concept of inequality in the modern era is inseparable from the quantitative data used to define it. Unlike historical perspectives of inequality, which relied on narrative accounts of poverty and wealth, modern definitions of inequality virtually always include some type of statistical measure such as GINI coefficients, Theil Statistics, and share of wealth or income owned by population quantiles. Tables of data, however, do not lend themselves to effective communication with a mass audience, making visualization a critical aspect of modern inequality literature.

In this paper I will analyze how Thomas Piketty uses data visualization in *Capital in the 21st Century* to make his case. The book contains a plethora of visualizations, including 96 graphs and 18 tables, which Piketty uses to reinforce the arguments being made by the text. I will be examining the integrity of these visualizations and how they interact with the arguments of *Capital in the 21st Century.*

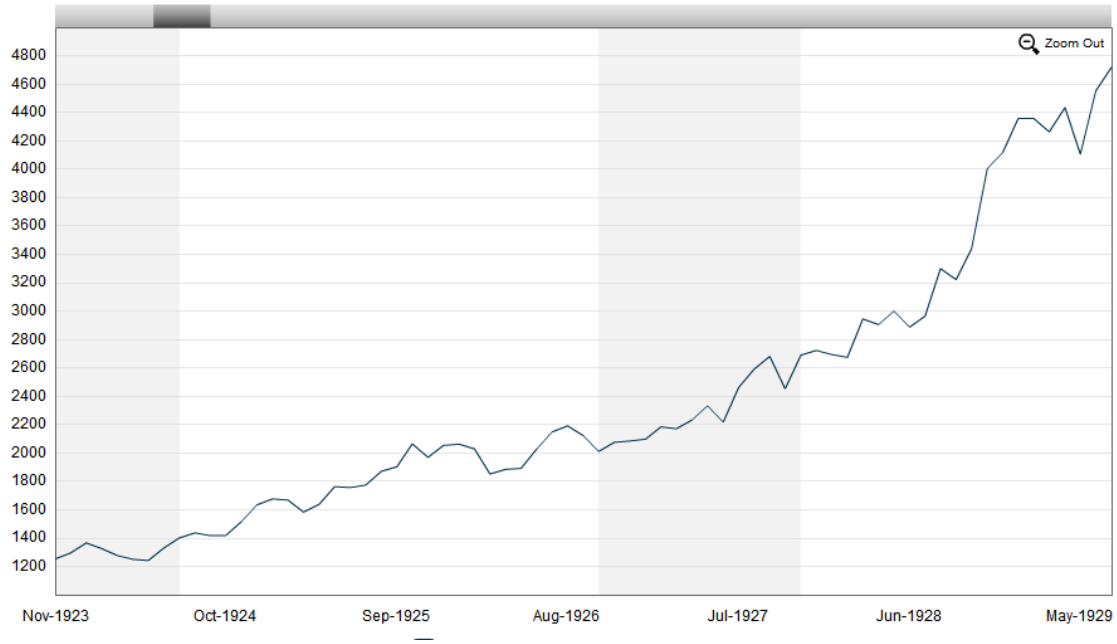
This paper will be organized as follows: first, I define the criteria of "proportionality" and "context" by which I am evaluating the integrity of Piketty's visualizations. Then, I examine the proportionality and context of specific graphs used in *Capital in the 21st Century*. Part of this examination includes reformatting Piketty's graphs by removing disproportionate axes and hypothetical context. These reformatted graphs are then compared to their originals as well as the language in the text describing them. Frequently, the data being visualized does not support the arguments of the text once it is formatted without speculation or distortion. To conclude, I summarize how Piketty's less defensible visualization choices are necessitated in large part by the nature of the book's arguments.

Before I can criticize "integrity" I will need to define it for the purpose of this paper. Edward Tufte devotes an entire chapter to graphical integrity in *The Visual Display of Quantitative Information*, a seminal text in the history of data visualization. In this chapter, Tufte identifies general principles of integrity in data visualization. For the purposes of this analysis, I will be focusing on the two most relevant to *Capital in the 21st Century*: proportionality and context. Tufte defines data proportionality as follows: "the representation of numbers, as physically measured on the surface of the graphic itself, should be directly proportional to the numerical quantities represented" (Tufte 1983, p.56). Tufte even proposes a method of measuring the distortion of this proportionality called the Lie Factor, in which the size of the effect shown in the graphic is divided by the size of the effect shown in data. For example:



This is the exact graphic Tufte uses to demonstrate a high lie factor. The change in the graphic is 5.3 inches – 0.6 inches, or 4.7 inches, indicating a 4.7/0.6 (783%) change. The change in the data, however, is 27.5-18, a 9.5/18 (53%) change. The total lie factor of this graphic is therefore 783/53, or 14.8. Lie factors are not an exact science, but they provide a rough conceptual framework for thinking about how one chooses to represent data.

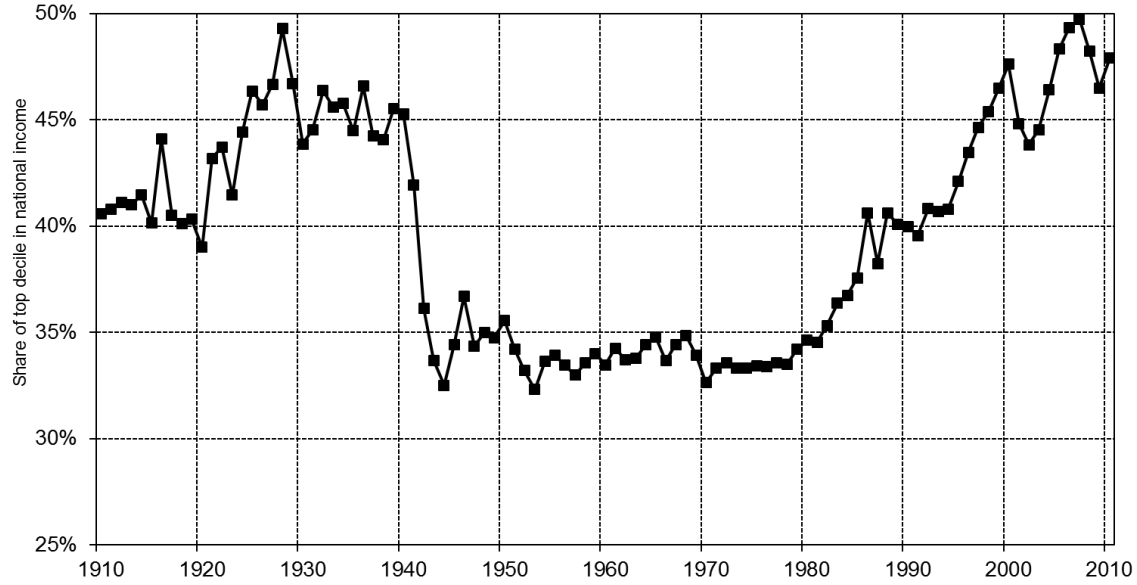
In addition to deliberate distortion of proportionality, the removal or addition of context can alter one's perception to the same extent. For example, this historical chart of the Dow Jones Industrial Average makes the stock market looks like a safe long-term investment circa May of 1929:



Source: http://www.macrotrends.net/1319/dow-jones-100-year-historical-chart

The visualizations in *Capital in the 21st Century's* come in two forms: tables of numbers and time-series line graphs. Almost every line graph is identical: the x-axis is years and the y-axis is an inequality measure or economic statistic. The following is the first graph that appears in the book, income inequality in the United States from 1910-2010 (Piketty 2013, p.24).

Figure I.1. Income inequality in the United States, 1910-2010



The top decile share in U.S. national income dropped from 45-50% in the 1910s-1920s to less than 35% in the 1950s (this is the fall documented by Kuznets); it then rose from less than 35% in the 1970s to 45-50% in the 2000s-2010s. Sources and series: see piketty.pse.ens.fr/capital21c.

Piketty describes the graph in his text as follows: [my italics]

> The US curve, shown in Figure I.1, indicates the share of the upper decile of the income hierarchy in US national income from 1910 to 2010. It is nothing more than an extension of the historical series Kuznets established for the period 1913–1948. The top decile claimed as much as 45–50 percent of national income in the 1910s–1920s before *dropping* to 30–35 percent by the end of the 1940s.
>
> Inequality then *stabilized* at that level from 1950 to 1970. We subsequently see a *rapid rise* in inequality in the 1980s, until by 2000 we *have returned to a level* on the order of 45–50 percent of national income. *The magnitude of the change is impressive. It is natural to ask how far such a trend might continue* (Piketty 2013, p.23).

In his description, Piketty tells the story of this graph for the reader. Inequality was high, inequality then "dropped", "stabilized", and saw a "rapid rise" that "returned" it to its previous level. Piketty likely starts with this graph because it's one of the major arguments of his book in miniature: that the declining inequality of Western Europe and the United States observed in the middle parts of the 20th century was temporary, and that the world is returning to a society defined by inherited wealth as in the 19th century.

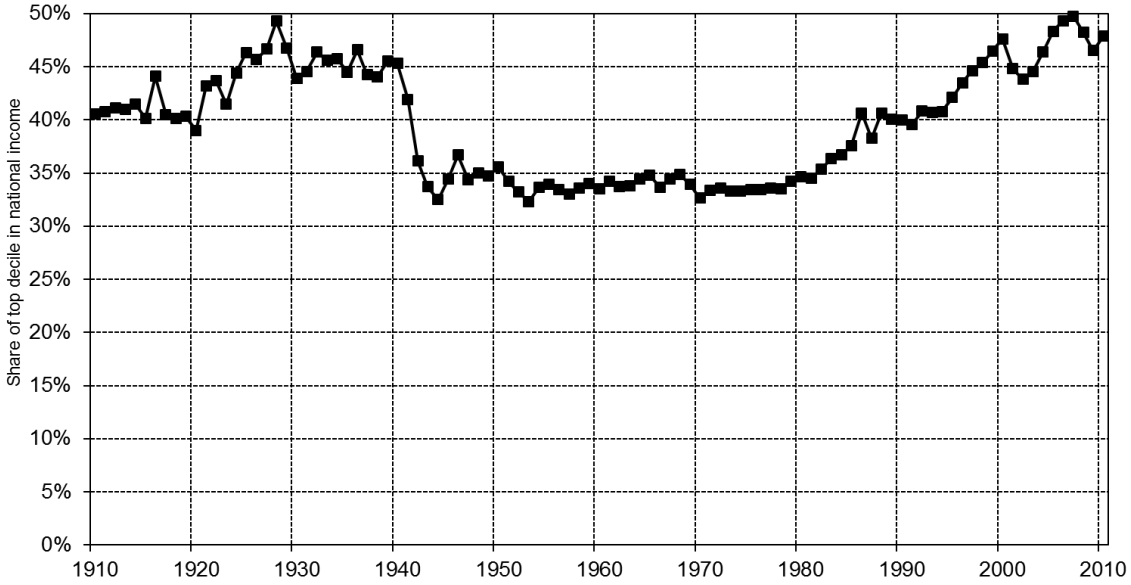
In terms of proportionality, this visualization has 1-to-1 correspondence between the data depicted on both axes. One unit of the X-axis represents ten years and one unit of the y-axis represents 5% of national income share controlled by top decile.

In terms of context, the graph depicts top decile share of national income, but the text does not specify whether this includes taxes and transfers.[1] It does specify that the data comes from tax records, but fails to mention one of the fundamental problems of using tax records: that they only measure reported income. Both of these factors change the results of the visualization: taxes and transfers reduce inequality, while underreporting of income in response to high tax periods (like the 1940s-1960s) could artificially reduce inequality for the duration of the period.

These data choices shape the graph into something that is visually consistent with Piketty's narrative: we are returning to the old world. This becomes apparent when we shift the Y-axis:

[1] A virtually identical version of this graph appears in "Striking it Richer: The Evolution of Top Incomes in the United States," a 2013 paper by Piketty's collaborator Emmanuel Saez. In this paper, Saez specifies that the data is pre-taxes and transfers (Saez 2014, p.8).

Figure I.1. Income inequality in the United States, 1910-2010



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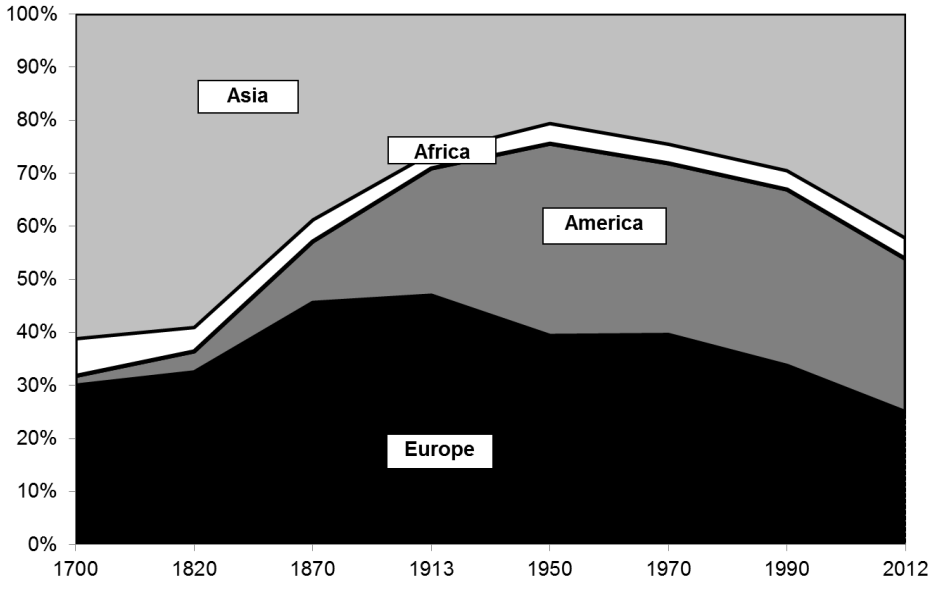
By definition, the top decile must control at least 10% of the wealth, so starting the Y-axis at zero as above is nonsense. Here I am illustrating a point: could Piketty describe inequality as rapidly rising in the 1980's based on the above visualization? His visualization makes the change in U.S. inequality look larger than this one, which aligns the visual with what Piketty emphasizes in his narrative of the world returning to how it used to be. This message appears numerous times throughout the book, with Piketty making frequent reference to the works of Jane Austen and Honore de Balzac in tandem with his economic arguments. While not such a problem for the above graph, throughout the book Piketty deliberately alters context and proportionality in his visualizations to fit them around this narrative. Of the 92 time-series graphs in the book, 25 have non-proportional X-axes.[2] The first of these to appear is Figure 1.1, seen below: (Piketty 2013, p.60).

Figure 1.1. The distribution of world output 1700-2012

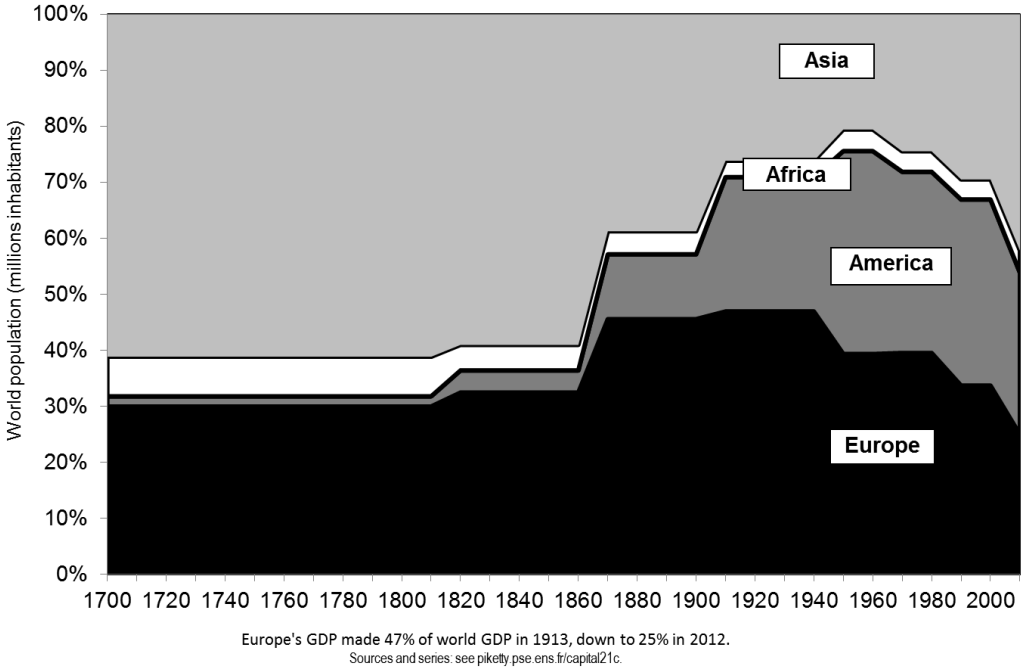


Europe's GDP made 47% of world GDP in 1913, down to 25% in 2012.
Sources and series: see piketty.pse.ens.fr/capital21c.

[2] See Appendix A for a full list.

One unit on the x-axis represents 120 years, then 50 years, then 63 years, then 37 years, then 20 years, then 20 years again, then 22 years. Almost every unit represents a different amount of time. The inconsistency makes Tufte's "lie factor" difficult to calculate, but the level of disproportion is about 6-fold: 120 years vs. 20 years. When the graph is displayed with a proportional x-axis, it looks as follows:[3]

Figure 1.1. The distribution of world output 1700-2012



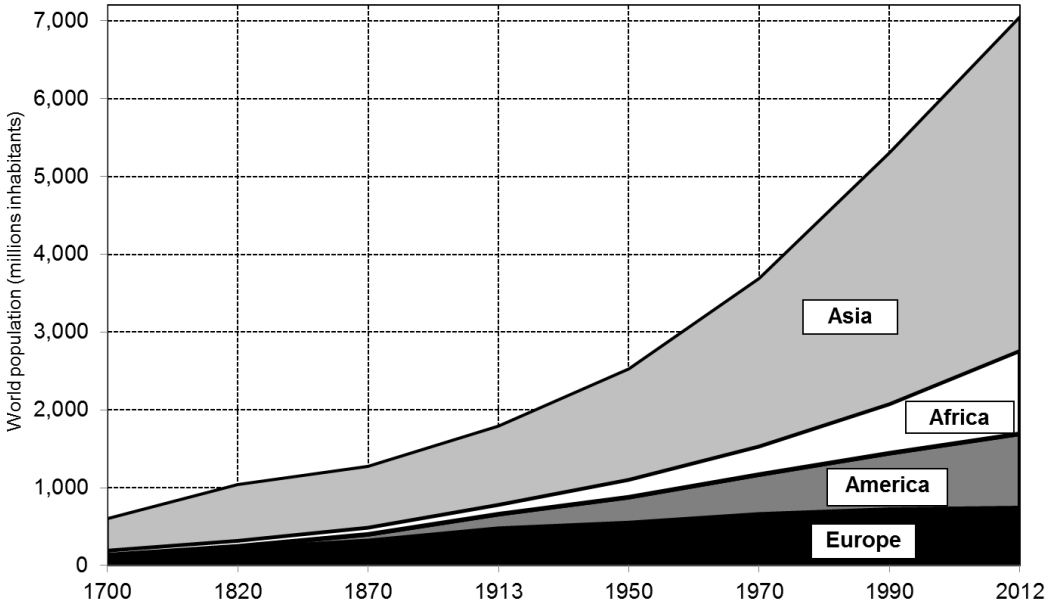
The effect of the disproportion is to emphasize the 20th century. Less than one third of the timeframe is the 20th century, yet this century occupies more than half of the figure. This emphasis also has the effect of visually depicting Piketty's narrative of a return to what used to be, as did figure I.1 showing U.S. income inequality. Both figures depict a beginning state of affairs, a change in that state of affairs in the middle of the graph, and at the end a gradual return.

This specific proportionality is used as the x-axis labeling convention for figures 1.2, 1.3, 2.1, 2.3, 2.6, and all six of the figures in chapter 3. Sometimes this proportionality does not change the fundamental shape of the data trend, as seen in figure 2.1 below. In these cases, the axis is likely chosen to make comparisons easier. In other cases, as seen in figure 2.3 below, this proportionality reshapes the graph into a curve that depicts a status quo, an alteration, and a return to that status quo along the lines of what is depicted above.

[3] This resizing is drawn from Piketty's data, which only includes the figures for the years in the original graph (1700, 1820, 1913, etc.). A year-by-year dataset would yield a much smoother graph, see Appendix B for technical details regarding the visualizations used in this paper.

Piketty's Graph: (Piketty 2013, p.75).

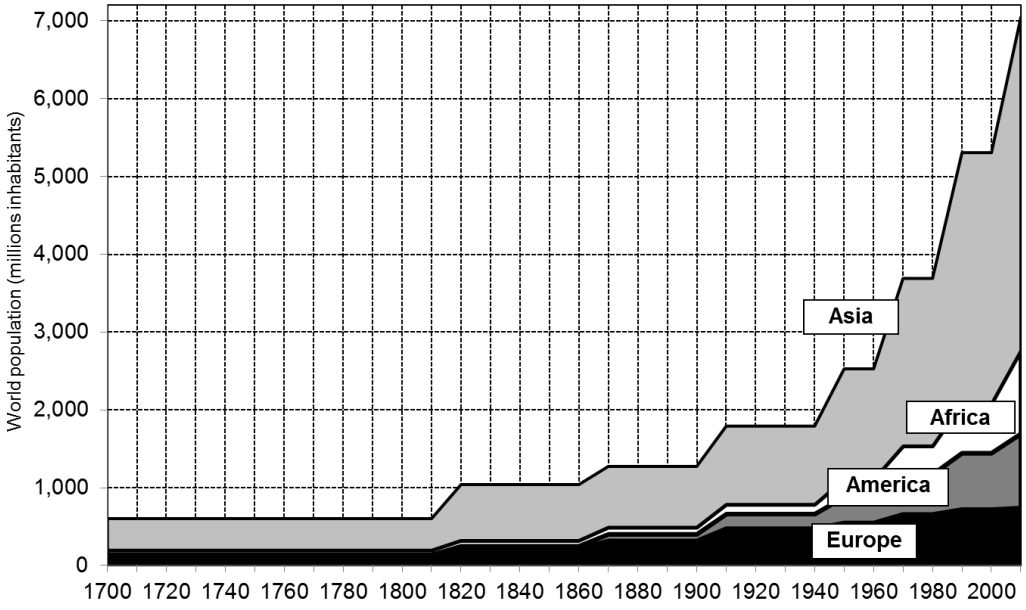
Figure 2.1. The growth of world population 1700-2012



World population rose from 600 million inhabitants in 1700 to 7 billion in 2012.
Sources ans series: see piketty.pse.ens.fr/capital21c.

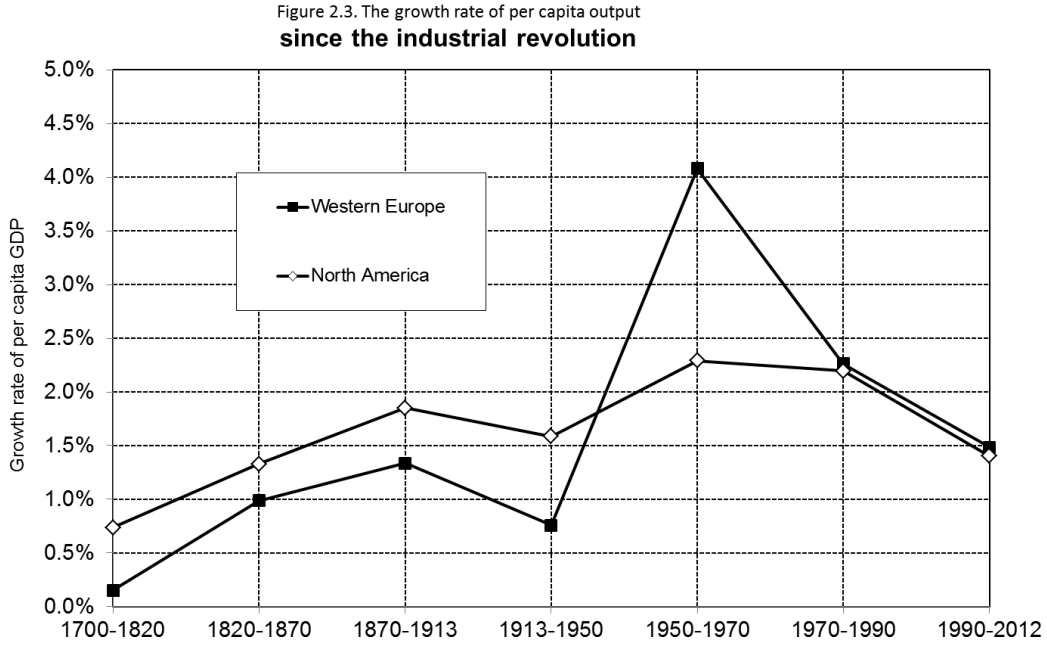
A proportional X-axis does not reshape the trend:

Figure 2.1. The growth of world population 1700-2012

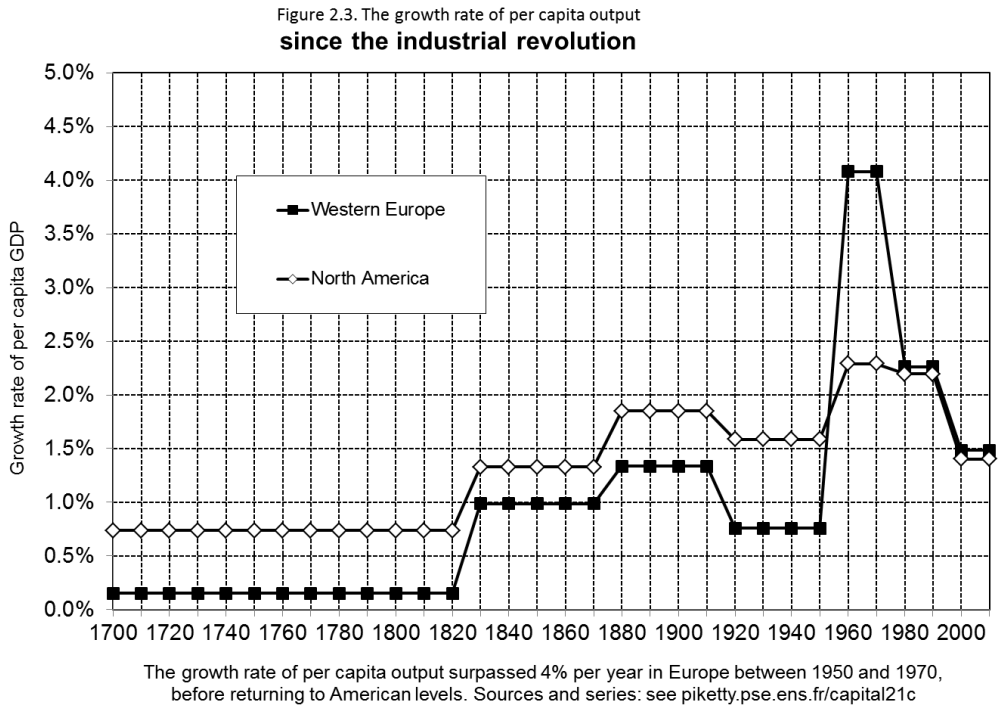


World population rose from 600 million inhabitants in 1700 to 7 billion in 2012.
Sources ans series: see piketty.pse.ens.fr/capital21c.

Piketty's graph: (Piketty 2013, p.97)



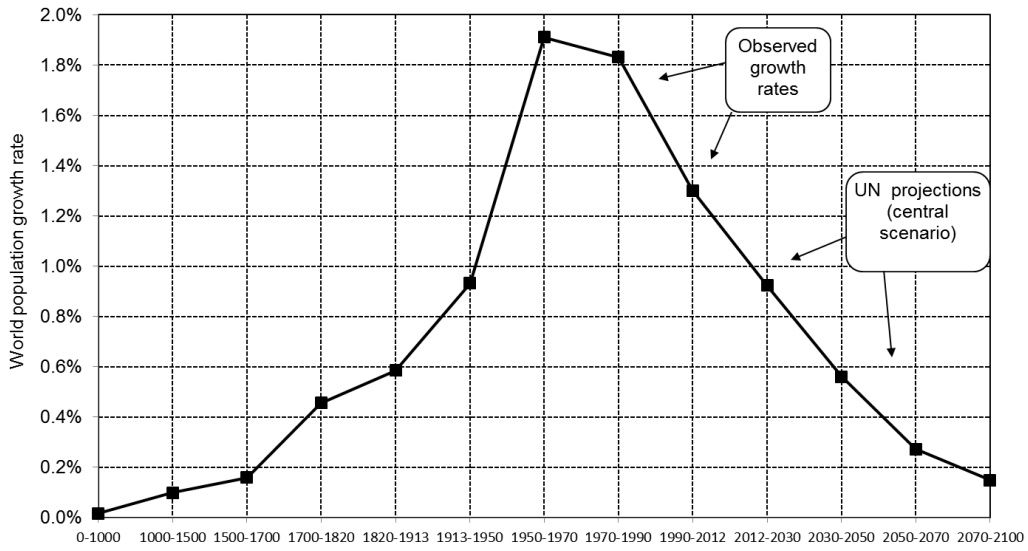
A proportional x-axis makes the trend look more flat:



In all of these cases, regardless of the change in shape, the years chosen from the 20th century stand out in these figures. The specific years were likely chosen due to the large role they play in the narrative of *Capital in the 21st Century*: 1913 (just prior to World War 1), 1950 (just after World War 2, when economic recovery

is in full swing), 1970 (when that economic recovery begins to stall), and 1990 (when inequality is widening once more). These years continue to be emphasized even in much longer timeframes than the graphs above, leading to severely disproportionate visualizations. The first of these is a graph of the world population growth rate over time, seen below (Piketty 2013, p.80).

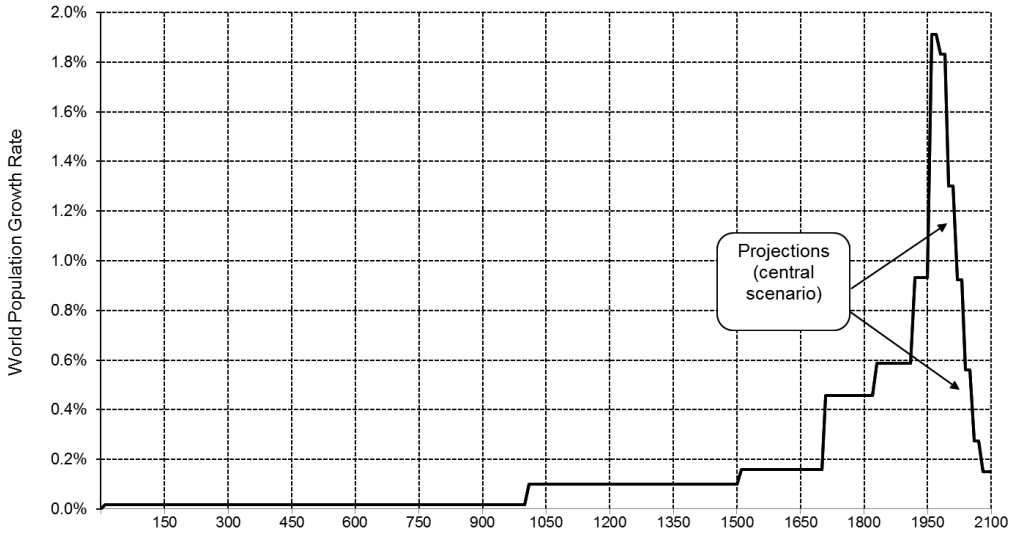
Figure 2.2. The growth rate of world population
from Antiquity to 2100



The growth rate of world population was above 1% per year from 1950 to 2012 and should return toward 0% by the end of the 21st century. Sources and series: see piketty.pse.ens.fr/capital21c.

The proportionality of the x-axis does not come close to matching the scale of the data. As with the above graphs, almost every unit represents a different amount of time, but this time the highest degree of disproportion is over 50-fold: 1000 years vs. 18 years, both represented by one unit. If each unit on the X-axis had the same value, the graph would look as follows:

Figure 2.2 The growth rate of world population
From Antiquity to 2100



The growth rate of world population was above 1% per year from 1950 to 2012 and should return toward 0% by the end of the 21st century. Sources and series: see piketty.pse.ens.fr/capital21c.

Piketty's description of the data reveals the story he tells with it: [my italics]

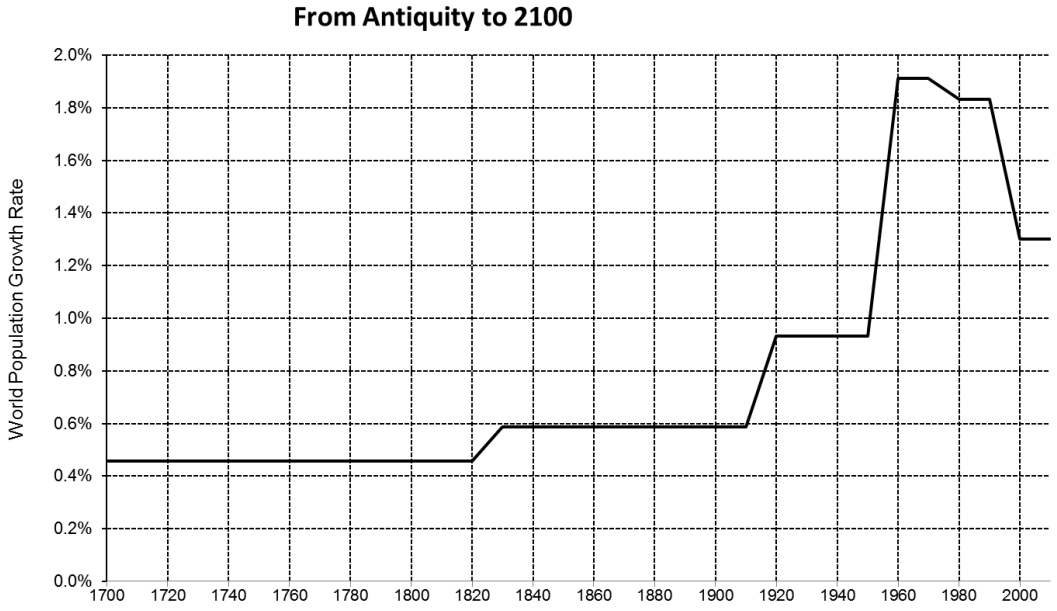
> According to official forecasts, progress toward the demographic transition at the global level should now accelerate, leading to *eventual stabilization* of the planet's population. According to a UN forecast, the demographic growth rate should *fall* to 0.4 percent by the 2030s and *settle* around 0.1 percent in the 2070s. If this forecast is correct, the world will *return* to the very low-growth regime of the years before 1700. The global demographic growth rate would then have followed a *gigantic bell curve* in the period 1700–2100, with a *spectacular peak* of close to 2 percent in the period 1950–1990 (Piketty 2013, p.79).

Piketty could not describe the proportional graph using the above language. While the proportional graph does contain a spectacular peak, it does not resemble Piketty's sloping bell curve. This graph shows the 20th century as an extremely brief, severe aberration, made all the more so by the inclusion of long-term historical estimates and speculative projections. Piketty himself even acknowledges that for 0 to 1700, the majority of this timescale:

> … the precision of such estimates is illusory. We actually possess very little information about the growth of the world's population between 0 and 1700 and even less about output per head. Nevertheless, no matter how much uncertainty there is about the exact figures (which are not very important in any case), there is no doubt whatsoever that the pace of growth was quite slow from antiquity to the Industrial Revolution, certainly no more than 0.1–0.2 percent per year (Piketty 2013, p.74).

These historical estimates are "not very important", yet they are included in the visualization. The reason for doing so becomes clear when we remove these historical estimates and future projections in addition to rescaling the x-axis:

Figure 2.2 The growth rate of world population



The growth rate of world population was above 1% per year from 1950 to 2012 and should return toward 0% by the end of the 21st century. Sources and series: see piketty.pse.ens.fr/capital21c.

This visualization does not look like a return to anything; the bell curve has disappeared. In addition to a disproportionate x-axis, Piketty has shaped the visualization by altering context. Rather than removing context, however, as I did in the stock market graph at the beginning of the paper, Piketty has added context to create the desired look for his visualization. For the above population graph, though, this additional data is questionable but not indefensible. The historical population growth rate has been very low from what we've been able to discern (if it hadn't been, there would be a great deal more people around now). Likewise, the observed population growth rate has been declining, and many if not most demographers and forecasters predict that it will continue to do so.

However, this addition of historical estimates and future projections becomes much more problematic in the next two graphs starting at antiquity, which depict growth rates of per-capita output and total output. Unlike population growth, the future projections in these are far less plausible. Piketty's own data does not show per-capita output declining in the real world, which means the projections of figure 2.4 showing this decline are entirely speculative. This alteration becomes much more apparent when Piketty's graphs as he presents them are compared with how they appear after the removal of projections, estimates, and disproportionate X-axes (as seen on the next page).

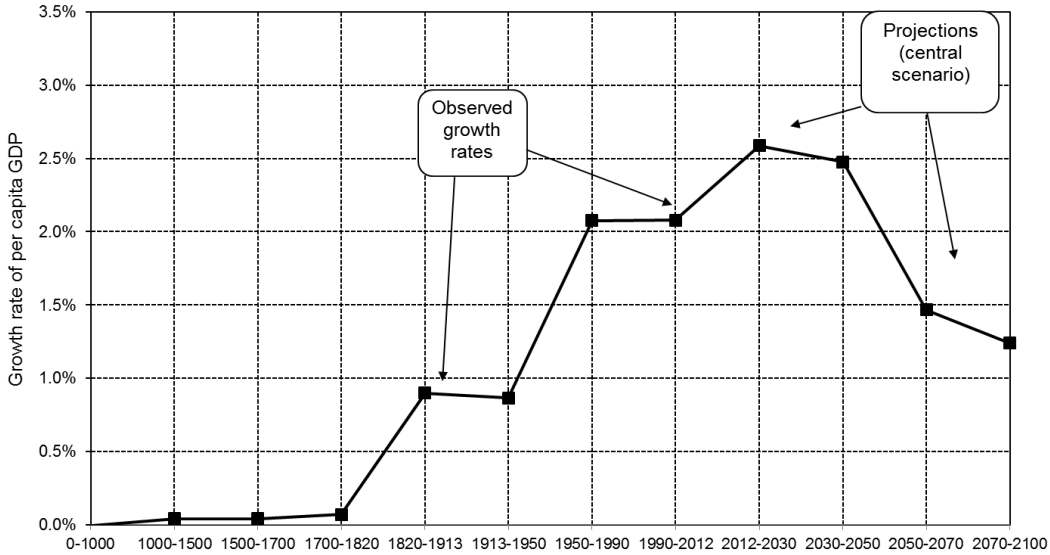
As with population, Piketty acknowledges the hypothetical nature of his projections in the text while simultaneously describing the phenomenon as a bell curve:

> I have already conceded that these "median" forecasts are highly hypothetical. The key point is that regardless of the exact dates and growth rates (details that are obviously important), the *two bell curves of global growth* are in large part already determined (Piketty 2013, p.102, my italics).

Yet there is nothing resembling a bell curve once the above adjustments are made.

Piketty's Graph: (Piketty 2013, p.100).

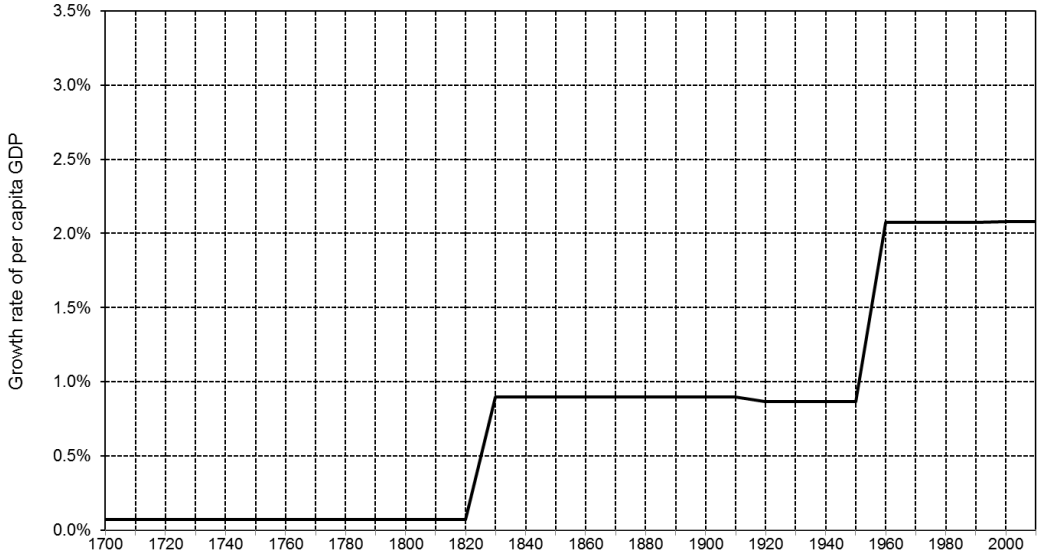
Figure 2.4. The growth rate of world per capita output
since Antiquity until 2100



The growth rate of per capita output surpassed 2% from 1950 to 2012. If the convergence process goes on, it will surpass 2,5% from 2012 to 2050, and then will drop below 1,5%.
Sources and series : see piketty.pse.ens.fr/capital21c.

Proportional X-axis, historical estimates and future projections removed:

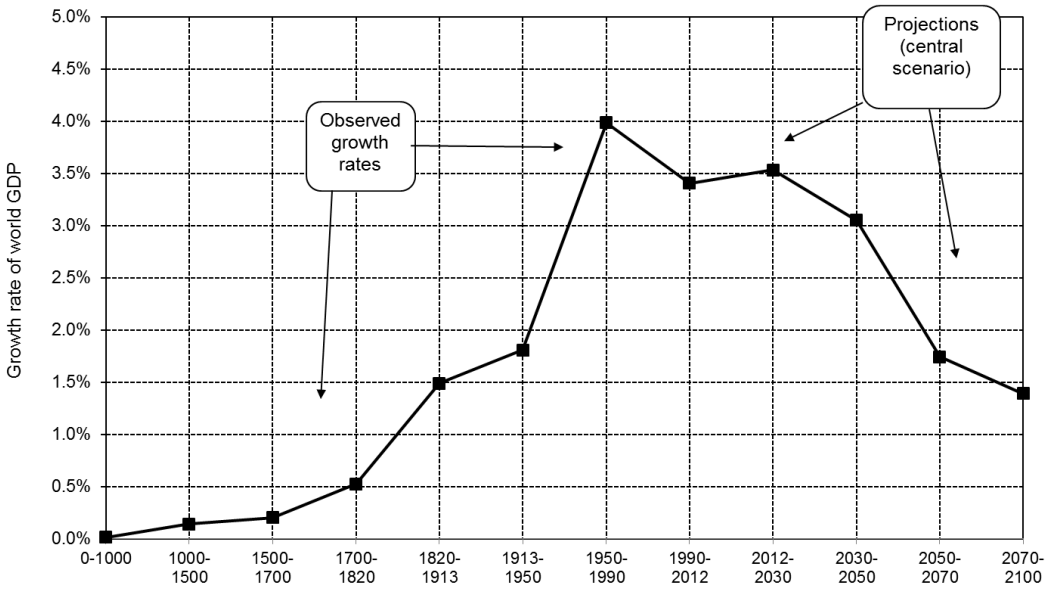
Figure 2.4. The growth rate of world per capita output
since Antiquity until 2100



The growth rate of per capita output surpassed 2% from 1950 to 2012. If the convergence process goes on, it will surpass 2,5% from 2012 to 2050, and then will drop below 1,5%.
Sources and series : see piketty.pse.ens.fr/capital21c.

Piketty's Graph: (Piketty 2013, p.101).

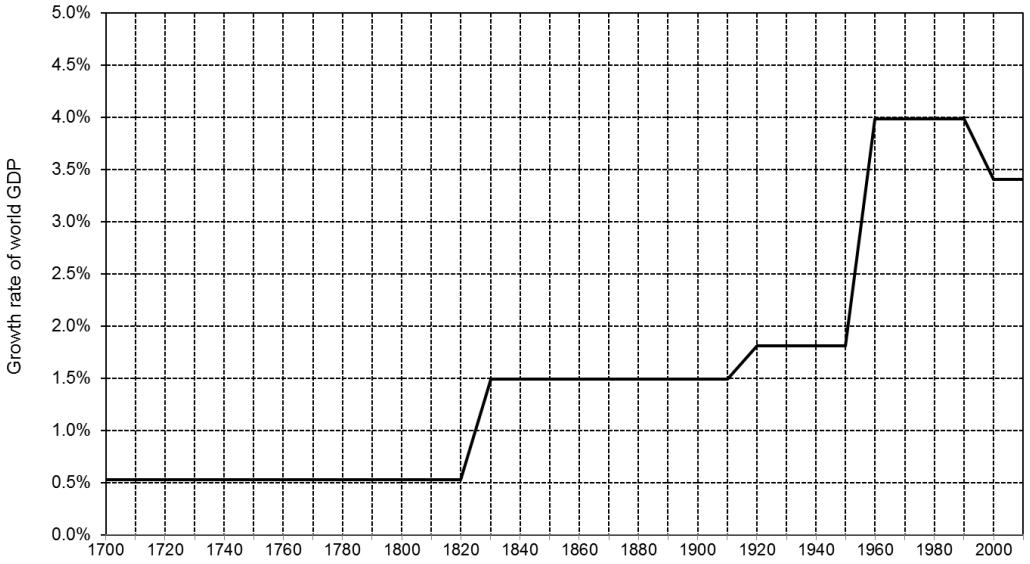
Figure 2.5. The growth rate of world output from Antiquity until 2100



The growth rate of world output surpassed 4% from 1950 to 1990. If the convergence process goes on it will drop below 2% by 2050. Sources and series: see piketty.pse.ens.fr/capital21c.

Proportional X-axis, historical estimates and future projections removed:

Figure 2.5. The growth rate of world output from Antiquity until 2100

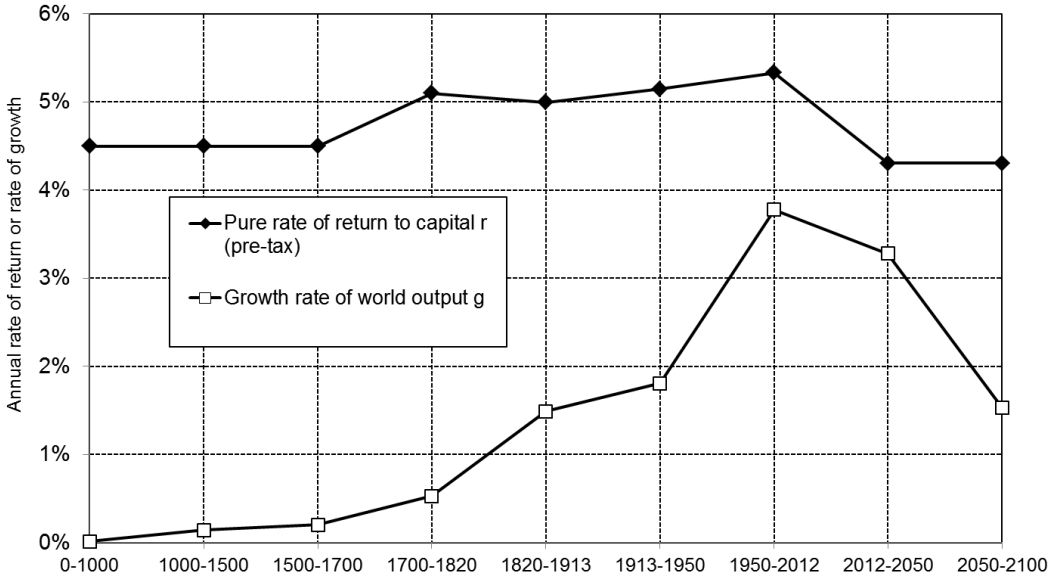


The growth rate of world output surpassed 4% from 1950 to 1990. If the convergence process goes on it will drop below 2% by 2050. Sources and series: see piketty.pse.ens.fr/capital21c.

The chapter 2 time-series graphs seen above play an important role in laying the groundwork for the graphs in chapter 10, which depict one of the central arguments of *Capital in the 21st Century:* that when the rate of return on capital ("r") exceeds the general growth rate ("g"), inequality tends to increase ("r>g"). The first of these, figure 10.9, essentially replicates figure 2.5 in its depiction of the growth rate of world output while

adding the trend-line for rate of return on capital:[4] (Piketty 2013, p.354).

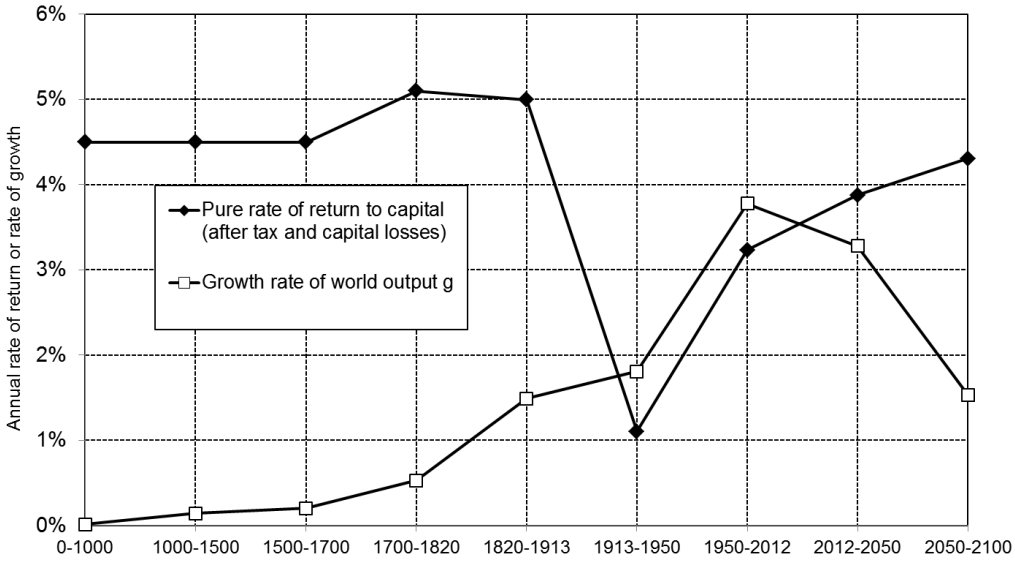
Figure 10.9. Rate of return vs. growth rate at the world level, from Antiquity until 2100



The rate of return to capital (pre-tax) has always been higher than the world growth rate, but the gap was reduced during the 20th century, and might widen again in the 21st century.
Sources and series: see piketty.pse.ens.fr/capital21c

Note that unlike in chapter 2, the hypothetical projections are not labeled as such. Piketty builds on this visualization by adding in the all of factors that reduced the rate of return on capital in the 20th century to create Figure 10.10 (Piketty 2013, p.356).

Figure 10.10. After tax rate of return vs. growth rate at the world level, from Antiquity until 2100

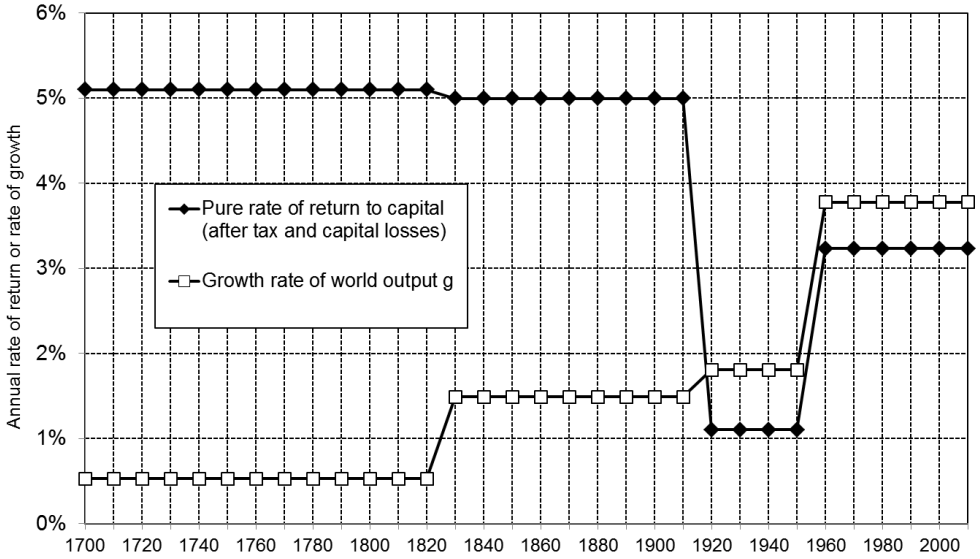


The rate of return to capital (after tax and capital losses) fell below the growth rate during the 20th century, and may again surpass it in the 21st century. Sources and series : see piketty.pse.ens.fr/capital21c

[4] Many critiques have already been written about Piketty's notion of "rate of return on capital," see Acemoglu and Robinson (2015), Galbraith (2014), and McCloskey (2014). For this reason, I will be focusing solely on visualization in this paper for the sake of brevity.

Here the 20th century is presented as a clear outlier during which the growth rate of the economy exceeded the rate of return on capital. Contrast this with how the figure appears with a proportionate x-axis when historical estimates and future predictions are removed:

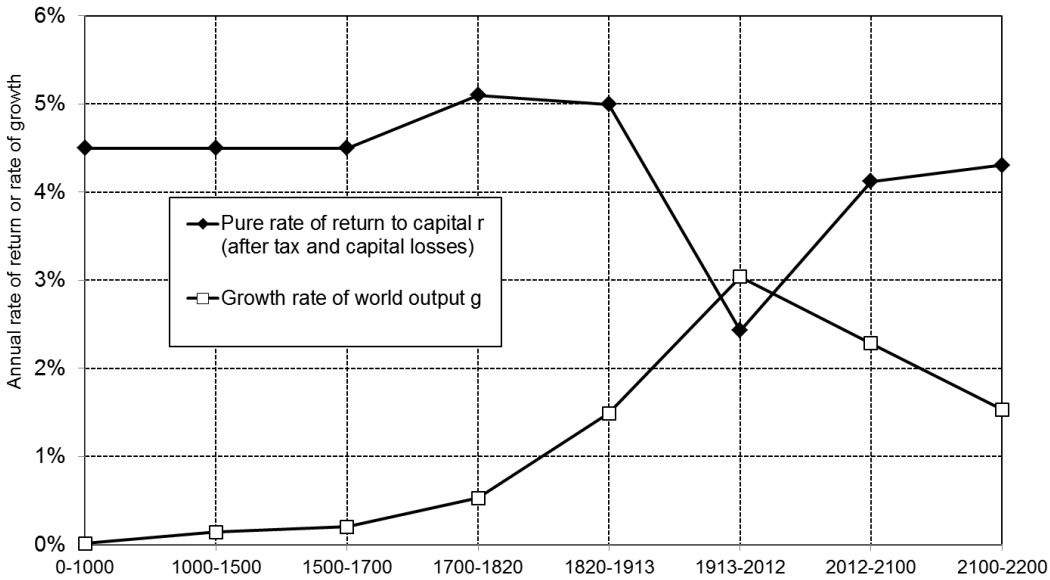
Figure 10.10. After tax rate of return vs. growth rate at the world level, from Antiquity until 2100



The rate of return to capital (after tax and capital losses) fell below the growth rate during the 20th century, and may again surpass it in the 21st century. Sources and series : see piketty.pse.ens.fr/capital21c

The rescaled visualization does show the unique character of the 20th century, but gives no reason to believe that this trend won't continue into the future. This particular point is so important to Piketty that on the page following figure 10.10 is an almost-identical graph designed to even further emphasize the idea that the world is returning to its pre-20th century state: (Piketty 2013, p.357).

Figure 10.11. After tax rate of return vs. growth rate at the world level, from Antiquity until 2200



The rate of return to capital (after tax and capital losses) fell below the growth rate during the 20th century, and might again surpass it in the 21st century. Sources and series: see piketty.pse.ens.fr/capital21c

Figure 10.11 collapses the entire 20th century into a single point and adds another hundred years of purely speculative projection that Piketty himself acknowledges as a "hypothesis" (Piketty 2013, p.357). Piketty justifies this decision as follows:

> To bring this possible evolution out even more clearly, I have combined in Figure 10.11 the two subperiods 1913–1950 and 1950–2012 into a single average for the century 1913–2012, the unprecedented era during which the net rate of return on capital was less than the growth rate. . . Figure 10.11 at least brings out the unprecedented—and possibly unique—character of the twentieth century in regard to the relation between *r* and *g* (Piketty 2013, p.357).

These visualizations would not be nearly as problematic were it not for the fact that Piketty uses them to make claims like the following:

> As Figure 10.9 shows, the pure rate of return on capital—generally 4–5 percent—has *throughout history always* been distinctly greater than the global growth rate, but the gap between the two shrank significantly during the twentieth century, especially in the second half of the century, when the global economy grew at a rate of 3.5–4 percent a year. In all likelihood, *the gap will widen again* in the twenty-first century as growth (especially demographic growth) slows (Piketty 2013, p.355, my italics).

There is a circular logic at work here, as Figure 10.9 has been designed to show the conclusions being drawn from it. But without his reshaped x-axes, historical estimates, and future projections, Piketty cannot make the case that his central argument holds true "throughout history always", a claim restated in the ultimate conclusion of this series of graphs:

> To sum up: the inequality r > g has clearly been true throughout most of human history, right up to the eve of World War I, and it will probably be true again in the twenty-first century (Piketty 2013, p.358).

Prior to these graphs, Piketty refers to *r>g* as the "fundamental force for divergence" (Piketty 2013, p.25), and goes on to refer to other components of his theory as "fundamental laws" (Piketty 2013, p.52). A "fundamental law" is one of the strongest claims one can make in social sciences, as a fundamental law must always be true in every conceivable circumstance, throughout history and forever into the future. Since its inception, the field of economics has been rife with claims of fundamental laws, from laws of history and laws of wages to now laws of inequality. When exceptions are found, proponents for these fundamental laws often make procrustean adjustments to data or theory so as not to violate their fundamental status. In this respect, Piketty's claim to his theory being a fundamental law necessitates his more problematic data visualizations. Piketty could have avoided the need for these problematic depictions by weakening his assumptions and/or limiting himself to non-speculative data. Had he done this, however, he could never have justified one of the central claims of his book: that the world is returning to what it was in the past. What the data actually shows is that we do not know where the world is heading.

Appendix A – Index of visualization characteristics in *Capital in the 21st Century*

Figure	Disproportionate X-axis?	Pre-1700 or future estimates?
0.1		
0.2		
1.1	Yes	
1.2	Yes	
1.3	Yes	
1.4		
1.5		
2.1	Yes	
2.2	Yes	Yes
2.3	Yes	
2.4	Yes	Yes
2.5	Yes	Yes
2.6	Yes	
3.1	Yes	
3.2	Yes	
3.3	Yes	
3.4	Yes	
3.5	Yes	
3.6	Yes	
4.1	Yes	
4.2	Yes	
4.3	Yes	
4.4		
4.5		
4.6	Yes	
4.7	Yes	
4.8	Yes	
4.9		
4.10	Yes	
5.1		
5.2		
5.3		
5.4		
5.5		
5.6		
5.7		
5.8		Yes
6.1		
6.2		
6.3		
6.4		
6.5		
6.6		
6.7		
6.8		
8.1		

Figure	Disproportionate X-axis?	Pre-1700 or future estimates?
8.2		
8.5		
8.6		
8.7		
8.8		
9.1		
9.2		
9.3		
9.4		
9.5		
9.6		
9.7		
9.8		
9.9		
10.1		
10.2		
10.3		
10.4		
10.5		
10.6		
10.7		
10.8		
10.9	Yes	Yes
10.10	Yes	Yes
10.11	Yes	Yes
11.1		
11.2		Yes
11.3		Yes
11.4		
11.5		
11.6		Yes
11.7		Yes
11.8		
11.9		Yes
11.10		Yes
11.11		Yes
11.12		
12.1		
12.2		
12.3		
12.4		Yes
12.5		Yes
12.6		
13.1		
14.1		
14.2		

*Figures 4.11, 8.3, 8.4, 8.9, and 8.10 are not time-series and therefore not included above.

Appendix B – Technical Issues in Excel

The visualizations in this paper are drawn from the data made available by Thomas Piketty on his website for *Capital in the 21st Century*, http://piketty.pse.ens.fr/en/capital21c2. This data contains, for the most part, only what is presented in Piketty's figures. For example, Figure 2.2 appears in Piketty's spreadsheet as follows:

	World population (growth rate)	Europe	América	Africa	Asia
0-1000	**0.0%**	0.0%	0.1%	0.1%	0.0%
1000-1500	**0.1%**	0.2%	0.1%	0.1%	0.1%
1500-1700	**0.2%**	0.2%	-0.2%	0.1%	0.2%
1700-1820	**0.5%**	0.5%	0.7%	0.2%	0.5%
1820-1913	**0.6%**	0.8%	1.9%	0.6%	0.4%
1913-1950	**0.9%**	0.4%	1.6%	1.6%	0.9%
1950-1970	**1.9%**	0.9%	2.2%	2.4%	2.1%
1970-1990	**1.8%**	0.5%	1.7%	2.8%	2.0%
1990-2012	**1.3%**	0.1%	1.3%	2.4%	1.3%
2012-2030	**0.9%**	0.0%	0.8%	2.1%	0.8%
2030-2050	**0.6%**	-0.2%	0.4%	1.7%	0.3%
2050-2070	**0.3%**	-0.2%	0.1%	1.3%	-0.1%
2070-2100	**0.1%**	-0.1%	-0.1%	1.2%	-0.4%

(Sheet: Chapter2TablesFigures.xls, Tab: TS2.2)

There is additional data by region, but no additional data by year. In other words, the world population growth rate at 1760 or 1930 cannot be found in these tables, only the averaged values seen above. As a result, I produced my rescaled visualizations by reformatting the data as follows:

	World population (growth rate)	Europe	América	Africa	Asia
1800	0.5%	0.5%	0.7%	0.2%	0.5%
1810	0.5%	0.5%	0.7%	0.2%	0.5%
1820	0.5%	0.8%	1.9%	0.6%	0.4%
1830	0.6%	0.8%	1.9%	0.6%	0.4%
1840	0.6%	0.8%	1.9%	0.6%	0.4%
1850	0.6%	0.8%	1.9%	0.6%	0.4%
1860	0.6%	0.8%	1.9%	0.6%	0.4%
1870	0.6%	0.8%	1.9%	0.6%	0.4%
1880	0.6%	0.8%	1.9%	0.6%	0.4%
1890	0.6%	0.8%	1.9%	0.6%	0.4%
1900	0.6%	0.8%	1.9%	0.6%	0.4%
1910	0.6%	0.4%	1.6%	1.6%	0.9%
1920	0.9%	0.4%	1.6%	1.6%	0.9%
1930	0.9%	0.4%	1.6%	1.6%	0.9%
1940	0.9%	0.4%	1.6%	1.6%	0.9%
1950	0.9%	0.9%	2.2%	2.4%	2.1%

You will notice that I use 1910 above when Piketty's data lists 1913. This is because of the way Excel automatically formats axis coordinates to be equidistant from one another regardless of scale. The only way

around this would be to create a listing for every single year, but I chose decades because it is what Piketty does for most of his data points in these graphs. I have also used 2010 instead of 2012 and 2013 for the same reason.

Another problem I faced came from the fact that because these are annualized averages, multiple values could be chosen for the same year. To use the above table as an example again (I've copied the relevant section below), what should be used as the growth rate for 1970: 1.9%, 1.8%, or 1.85%?

Year	**World population (growth rate)**
1950-1970	**1.9%**
1970-1990	**1.8%**

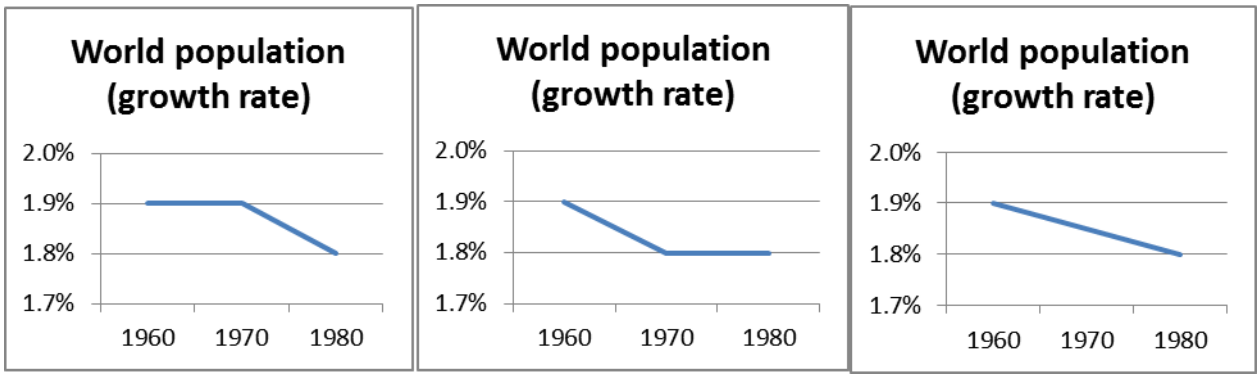
I can format it one of three ways:

Year	**World population (growth rate)**
1960	1.9%
1970	1.9%
1980	1.8%

Year	**World population (growth rate)**
1960	1.9%
1970	1.8%
1980	1.8%

Year	**World population (growth rate)**
1960	1.9%
1970	1.85%
1980	1.8%

… each of which produces a slightly different visual:



For the graphs I produced in this paper derived from averages, I went with the option on the left, using the first listed value for a given decade. Using the middle option would have created unevenly sized categories: the final 20 years would have had three entries as opposed to two. The option on the right I ruled out as extrapolation.

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The Price Cannot be Right: Taxation, Sub-Intrinsic-Value Housing Bubbles, and Financial Instability

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Abstract

A "general formula" for the rental yield of a property is derived in terms of an exponential appreciation rate, a discount rate, a holding time, and a set of tax parameters, on the hypothesis that prices reflect net present values (NPVs) of future cash flows. Special cases are noted and interpreted. The formula explains the counterintuitive observation that a stamp duty on the purchaser can reduce the price by more than the value of the duty, and similarly predicts that a subsidy for the purchaser can raise the price by more than the value of the subsidy. But for some combinations of inputs, the formula predicts prices that clearly exceed buyers' capacity to service loans. If the financial system tries to support such high prices, there will be a sub-intrinsic-value bubble – a condition in which prices, although lower than NPVs, are unsustainable due to unserviceable debt. The suggested remedy is to change the tax mix so as to bring NPVs within buyers' capacity to service loans. This can be done by relying more heavily on land tax or capital-gain tax. As the latter does not need to be paid out of current income, it is more conducive to home ownership.

Keywords: efficient markets, property, bubbles, financial instability, economic rent

1. Introduction

If the real-estate market were efficient, the price of a property would not systematically deviate from the net present value (NPV), which is the discounted present value (PV) of the future cash flows imputable to the property. Future increases in the rental value, and therefore in the price, would be reflected in the current price. Hence ownership of landed property would not systematically yield super-normal returns ("economic rent") unless the property had been acquired for less than the market price.[4]

Critics of the efficient-market hypothesis might allege that the applied discount rate can be too low, either because central banks impose artificially low interest rates (the "Austrian" explanation), or because risk and uncertainty are underpriced due to a period of steady growth (the "Minskian" explanation) or the rise of "originate-to-distribute" lending (whereby credit risk becomes someone else's problem). Or they might allege that an initially rational market can degenerate into a Ponzi scheme as the discounting of increasing rents gives way to the pursuit of capital gains, then to belief in the greater fool, then to belief in the greater believer in the greater fool, and so on, until belief becomes foolishness. These theories all imply that property can be overpriced – in which case the buyers, far from being net recipients of economic rent, are losers, not only by comparison with their counterparties but also in absolute terms. According to these theories, a bubble is a condition in which prices exceed NPVs, and the subsequent "burst" is the inevitable correction, which begins when prices are furthest from NPVs.

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[3] Disclosure: The author is not exposed to shares or real estate except through his compulsory superannuation. The Henry George Foundation and the Henry George Club hold investment portfolios whose compositions may change from time to time and may include shares and real estate.
[4] Here I use the term *economic rent* in the micro-economic sense. From the macro viewpoint, as unimproved land has no cost of production, its entire rental value is economic rent. But from the micro viewpoint, land usually has a cost of acquisition, in which case only super-normal returns on that cost are economic rent. Thus the economic rent as defined from the macro viewpoint may not accrue to the current owners.

This paper, in contrast, proposes that NPVs can exceed the maximum debts that buyers can service out of current income, in which case the buyers, in their competitive efforts to drive up prices towards NPVs, may take on more debt than they can service. In this scenario, which I call a sub-intrinsic-value bubble,[5] prices become unsustainably high while remaining below NPVs. The ensuing "burst" is the belated realization that current prices require too much debt and begins when prices are, ironically, closest to NPVs. Owners who bought at the top of the market are losers in the sense that they would have done better to buy at another time, but not in the sense that they paid more than NPVs; on the contrary, having paid less than NPVs, they will eventually be net recipients of economic rent if they can hold their properties for long enough (a big "if"). In the meantime, the higher the price/rent ratio, the higher the fraction of the rent that will accrue to the lender under the guise of the interest margin.

After the bubble bursts and the bad debts are somehow worked out, prices will start rising again, and the cycle will repeat. But in the case of a sub-intrinsic-value bubble, the price of a property at any stage of the cycle, being less than the NPV, will be determined by what one can borrow against the property, and will bear little relation to its rental value in the short term. Only in the long term will there be a proportionality between prices and rents, as the capacity to service loans and the capacity to pay rent are both constrained by current income.

There is no inherent contradiction in the claim that NPVs can exceed buyers' capacity to service debt; NPV is a balance-sheet measure, while debt-servicing capacity is a cash-flow constraint. Moreover, it is well known that the NPV of an exponentially growing rent stream increases without limit as the growth rate approaches the discount rate, in which case the interest on the NPV likewise increases without limit. Furthermore, the relevant rental growth rate is that of a fixed address, and tends to be faster than that of the "average" or "median" property, which moves further from city centers as population grows, and whose rental value is limited by per capita income. The growth rate for a fixed address, being a function of income growth and population growth, is not constrained by the discount rate.

As the "sub-intrinsic-value bubble" theory concerns cases in which prices remain below NPVs, it is obviously not consistent with an efficient market. But it is consistent with rationality in the sense that buyers are attempting to drive prices towards NPVs. It is consistent with the "greater fool" theory if the primary foolishness is understood as over-estimation of one's capacity to service loans. It is consistent with the "Austrian" theory if artificially low interest rates are blamed for the over-estimation. It is consistent with the "Minskian" theory, not quite in the sense that "stability is destabilizing", but rather in the sense that striving after stability is destabilizing: stability is not achieved until prices reach NPVs, which they cannot, because the associated debts would be unserviceable.

If a property market were suffering from a sub-intrinsic-value bubble, the existence of the bubble would be deniable. The "bulls" would be able to claim that prices were more than justified by "fundamentals", that regulation of lending should be relaxed to let buyers borrow amounts commensurate with NPVs (which would always be sufficient to pay off any loans that became unserviceable due to loss of income), that prospective buyers should buy now to avoid higher prices, and that any talk of a bubble would be irresponsible and dangerous because it might damage confidence. Hence, when the bubble started to deflate, the bulls could further claim that the improvement in "affordability" had created a "buyers' market", which could not last, because prices were even further below NPVs. Hence, when the crash gathered momentum and led to financial crisis and recession, the wounded bulls would claim that the fall in prices, and not the preceding rise, had been irrational, that "no one could have seen this coming", and that government interventions, other than those calculated to support prices and protect creditors, were unwarranted. These predictions bear some resemblance to recent history, suggesting that sub-intrinsic-value bubbles are worth investigating.

The investigation in this paper is mathematical: the gross rental yield is expressed in terms of a set of parameters describing the tax system, the property market, and the financial market, on the hypothesis that the price is the NPV. For values of the parameters that predict impossibly low rental yields – that is, impossibly high prices – the actual market prices will remain below NPVs (contradicting the hypothesis), but

[5] This term equates the "intrinsic" value with the NPV—not with the cost of production, which excludes the unimproved land value. Possible alternative terms are *sub-NPV bubble* and *sub-fundamental-value bubble*.

the market will tend to form sub-intrinsic-value bubbles, which in turn will cause financial crises. This paper does not quantitatively model the economic cycle. Much less does it predict a cycle of cycles, with the outer cycle ending in a "great moderation" before a great collapse (cf. Keen, 2011: 334, 374). It merely finds conditions, including tax settings, under which equilibrium and "efficient" markets lead to absurd price/rent ratios.

2. Simplified analysis: Property held for a short time

Suppose that a property is purchased, held for a period T, and then resold. Suppose further that T is short enough to allow **linearizing approximations**: e.g., if P_0 is the purchase price and y is the rental yield and g (for growth) is the appreciation rate, then the rent received during the holding period is near enough to yP_0T, and the capital gain on resale is near enough to gP_0T.

The disadvantage of assuming a short holding time is the loss of generality (to be rectified in Section 4). The advantage is a simple formula for rental yield, incorporating all desired parameters of the tax system and allowing a qualitative description of the effects of the various taxes on property prices. The formula can first be derived for the case in which there are no transaction costs (other than capital-gains tax, which is handled separately). Transaction costs can then be introduced by deducting them from the capital gain.

2.1 Without transaction costs

Concerning the tax system, I make the following assumptions and definitions:

- h is the **holding charge rate**, expressed as a fraction of the current market price per unit time, and is constant over the holding period. It allows for all recurrent property taxes or "rates" imposed by all levels of government, plus any maintenance costs and body corporate fees. For the purpose of defining h, the "current market price" is inclusive of any buildings or other improvements (even if, in order to avoid penalizing construction, the legislated tax rate is levied on the site value or unimproved value).

- u is the fraction of **current income** and current expenses remaining after income tax, and is constant over the holding period. If the marginal tax rate is τ, then $u = 1 - \tau$ (for example, a tax rate of 30% gives u =0.7=70%). For the purposes of this paper, u applies to property income and associated expenses. It need not apply to other sources of income, such as labor (although it probably does under current policies).

- v is the fraction of a **capital gain** remaining after income tax, and is constant. (For example, if the capital-gains-tax rate is 15%, then $v = 0.85 = 85\%$; and if capital gains are untaxed, as for owner-occupied residential properties in Australia, then $v = 1$.)

- Any **indirect taxes** or **consumption taxes** need not be modeled explicitly, because they effectively devalue the currency in which all other quantities are measured, without changing the proportionalities between those quantities.

(Assumptions and definitions given as bullet points are retained throughout the paper.)

Under equilibrium conditions, the cost must equal the benefit over the purchase-resale cycle; that is, the rent received or saved plus the capital gain must equal the interest paid or forgone plus the holding cost, where all quantities are after tax. Let P_0 be the purchase price, y the gross rental yield, g the appreciation rate, and i the pre-tax interest rate. Then, under our linearizing approximations, the rent received or saved during the holding period is yP_0T, which becomes uyP_0T after tax; and the capital gain is gP_0T, which becomes vgP_0T

after tax; and the holding cost is hP_0T, which becomes uhP_0T after tax; and the interest is iP_0T, which becomes uiP_0T after tax. With these substitutions, the cost-benefit balance becomes

$$uyP_0T + vgP_0T \approx uhP_0T + uiP_0T. \quad (1)$$

Canceling the common factor and solving for y, we get

$$y \approx h + i - \frac{v}{u}g. \quad (2)$$

(If $= u$, this result simplifies to $y \approx h + i - g$, which may be more familiar to the reader. If, in addition, we set $h = 0$ and interpret i as a discount rate, we obtain the familiar rule that "the yield is the discount rate minus the growth rate." Notice that these familiar results are less general than Eq. (2), which in turn is less general than the results to follow.)

Eq. (2) implies that the holding charge rate h and the interest rate i are additive (that is, their combined influence on y depends on their sum), and that capital gains are magnified by the factor v/u relative to current income and expenses.

For a given rent, the price increases without limit as $y \to 0$. And there is nothing in Eq. (2) to prevent y from falling to zero. A high price (small y) is especially likely if the holding charge is low (i.e., h is small) or capital gains are taxed at a lower rate than current income ($v/u > 1$).

2.2 With transaction costs

To account for transaction costs (not including capital-gains tax), I further assume:

- s is the stamp duty rate payable by the buyer on the purchase price of a property, and is constant. A negative value indicates a net grant or subsidy.

- r is the resale cost payable by the seller, expressed as a fraction of the resale price, and is constant. It includes any commissions and legal fees and any "vendor stamp duty" on the sale price, but not capital-gains tax.

- For the purpose of calculating the taxable capital gain, resale costs are deducted from the resale price, and any stamp duty on the purchase price is included in the cost base; in other words, the transaction costs of the purchase and resale are deducted from the taxable capital gain.

In the derivation of Eq. (1), the purchase price is P_0, on which the stamp duty is sP_0 , and the resale price is $P_0(1 + gT)$, on which the resale cost is $rP_0(1 + gT)$. When the stamp duty and resale cost are deducted from the pre-tax capital gain in Eq. (1), namely gP_0T, the net taxable capital gain is

$$\left[g(1 - r) - \frac{s + r}{T}\right]P_0T, \quad (3)$$

which replaces gP_0T in Eq. (1). The interest term in Eq. (1), namely uiP_0T, must be replaced by $ui(1 + s)P_0T$, because interest is paid or forgone on $(1 + s)P_0$ instead of P_0. Making these substitutions in Eq. (1) and simplifying, we obtain

$$y \approx h + i(1 + s) + \frac{v}{u}\left[\frac{s + r}{T} - g(1 - r)\right]. \quad (4)$$

If s is small, h and i are still approximately additive. Lower holding costs still mean lower rental yields (higher prices). If T is long enough to make the square-bracketed expression negative – i.e. long enough to make the gross capital gain outweigh the transaction costs – then it is still true that concessional taxation of capital gains ($v/u > 1$) means lower yields (higher prices).

Eq. (4), unlike Eq. (2), includes T, and implies that a longer holding time means a lower yield, hence a higher price. This means in practice that, all else being equal, buyers who intend to hold for longer will make higher bids.

Eq. (4) further implies that the stamp duty rate s raises y and therefore reduces the price/rent ratio. The same is true of the resale cost r (at least if $g \geq 0$). We shall see in Section 7 that, contrary to the prediction of conventional supply-and-demand curves, the reduction in price due to stamp duty can exceed the value of the duty.

3. Assumptions and definitions

The assumptions and definitions given in the preceding bulleted lists are retained throughout the paper. For the general case, in which the holding time T is not necessarily short, I make the following assumptions concerning the property market and the financial market:

- At time t, the gross rent of the property under study is

$$E = E_0 e^{gt}, \tag{5}$$

  where E_0 and g are constant during the holding period. In other words:

  - E_0 is the initial rent (at $t = 0$); and
  - g is the continuously compounding rental **growth rate**; that is, $g = E'/E$, where the prime ($'$) denotes differentiation w.r.t. time (e.g., if $g = 0.04\,\mathrm{yr}^{-1}$, the growth rate is 4% "per annum" over an infinitesimal period, but compounds to slightly more than 4% over a full year).

- i is the continuously-compounding **grossed-up discount rate**, and is constant for future cash flows through the holding period; in other words, the continuously-compounding *after-tax* discount rate is ui , so that a future cash flow at time t must be multiplied by

$$e^{-uit} \tag{6}$$

  to find its present value (PV) at time 0. This notation does *not* imply that the grossed-up discount rate is "given" (exogenous) and that the after-tax rate is proportional to u; it is equally compatible with (e.g.) the hypothesis that ui is "given" so that i is *inversely* proportional to u. Nor does it imply that i is a pre-tax discount rate.[6] But it is convenient because there are special cases (including those already considered) in which i can be interpreted as the pre-tax *interest* rate.

[6] For the purpose of calculating a PV, the *after-tax* discount rate is applied to *after-tax* cash flows. In contrast, the "*pre*-tax discount rate" is a notional discount rate that can be applied to the corresponding *pre*-tax cash flows to obtain the same PV (Lonergan, 2009:42). In the *special case* of a perpetuity with no growth, dividing the pre-tax annual flow by the grossed-up discount rate happens to yield the correct PV, so that the "pre-tax" discount rate is the grossed-up rate in this case. In general, however, the "pre-tax" discount rate is not necessarily the grossed-up rate, even if all pre-tax cash flows are simply grossed-up after-tax cash flows (Lonergan, 2009:44). If the proportionality between pre-tax and after-tax cash flows is not uniform (e.g. because taxable income is not identical with cash flow), further complications arise (Davis, 2010:4). Accordingly, I avoid the notion of a "pre-tax" discount rate.

- y is the gross rental **yield**, and is constant during the holding period; that is, if P is the market price at any time and E is the gross market rent at the same time, then

$$E = yP, \tag{7}$$

where y is constant during the holding period. Thus the P/E ratio is $1/y$ and is likewise constant during the holding period.

From Eqs. (5) and (7) we have

$$P = E_0 e^{gt}/y, \tag{8}$$

showing that the rental growth rate g is also the price growth rate. The initial price (at $t = 0$) is

$$P_0 = E_0/y. \tag{9}$$

The assumption of **equilibrium** is embodied in the assumptions that s, r, h, u, v, g, i and y are constant through the holding period. Of these constants, g (hence v) and i (hence u as applied to interest) depend on whether values are **real** (adjusted for inflation) or **nominal** (not adjusted). In principle we can define inflation-sensitive constants in nominal terms or real terms, as long as we are consistent. But reality may cause one convention to be more convenient than the other. In particular, if the tax system assesses nominal interest and nominal capital gains (as in Australia), it is convenient to define all constants in *nominal* terms.

4. General analysis

Let the property be bought at $t = 0$ and sold at $t = T$. Let P_0^{rent} denote the PV of the rent received during the holding period, and let P_0^{resale} denote the PV of the resale price, where both the rent and the resale price are net of taxes and other costs (but not interest, which is accounted for in the discount rate). For the initial buyer, the NPV is the sum of P_0^{rent} and P_0^{resale}, and depends on the anticipated holding period T (which may be different for different buyers).

Before income tax, the rent net of holding charges is $E - hP$. *After* income tax, the net rent received or saved during an infinitesimal interval dt is

$$u(E - hP)dt, \tag{10}$$

which we multiply by e^{-uit} to obtain its present value. Adding the PVs for all the infinitesimal intervals, we have

$$P_0^{rent} = \int_0^T u(E - hP)\, e^{-uit}\, dt. \tag{11}$$

Substituting from Eqs. (5) and (8), we find

$$P_0^{rent} = uE_0(1 - h/y) \int_0^T e^{(g-ui)t}\, dt \tag{12}$$

$$= \frac{E_0(1 - h/y)}{i - g/u}\left[1 - e^{(g-ui)T}\right] \tag{13}$$

provided that

$$g - ui \neq 0. \tag{14}$$

The acquisition price including duty is $P_0(1+s)$, which, by Eq. (9), can be written

$$E_0(1+s)/y. \tag{15}$$

The resale price [from Eq. (8)] is $E_0\, e^{gT}/y$. Resale costs reduce this to $E_0(1-r)e^{gT}/y$. Deducting the acquisition cost (15), then multiplying by v, we obtain the after-tax capital gain

$$\frac{vE_0}{y}[(1-r)e^{gT} - (1+s)].$$

We add this to the cost base (15) to find the after-tax resale price, which is then discounted to find its present value, denoted by P_0^{resale}. The result is

$$P_0^{resale} = \frac{E_0}{y}[(1-r)ve^{gT} + (1+s)(1-v)]e^{-uiT}. \tag{16}$$

Of course we obtain the same result if we subtract the capital-gains tax from the resale price (net of resale costs) and discount the difference.

If the price of acquisition (15) is the NPV, we have

$$E_0(1+s)/y = P_0^{rent} + P_0^{resale}. \tag{17}$$

The use of the price *including duty* on the left-hand side does not amount to an assumption that the price is simply reduced by the value of the duty. Rather, when we substitute from Eqs. (13) and (16), the yield y appears on both sides of the equation, which is solved in order to discover the effects of the various parameters on y, hence on the price. Making those substitutions and solving for y, we obtain the **general formula**

$$y = h + \frac{i - g/u}{1 - e^{(g-ui)T}}\{(1+s)[1-(1-v)e^{-uiT}] - (1-r)ve^{(g-ui)T}\} \tag{18}$$

provided that $g - ui \neq 0$ [Eq. (14)].

If, on the contrary, $g - ui = 0$, then the integrand in Eq. (12) is 1, so that Eq. (13) is replaced by

$$P_0^{rent} = uE_0T(1 - h/y), \tag{19}$$

with the result that Eq. (18) is replaced by

$$y = h + \frac{1}{uT}\{(1+s)[1-(1-v)e^{-uiT}] - (1-r)v\}. \tag{20}$$

Failure to make these replacements when $g - ui = 0$ would cause a "zero over zero" error in Eqs. (13) and (18).

5. Special cases

5.1 Short holding time (revisited)

Eq. (18) can be rearranged as

$$(y-h)e^{uiT} = \frac{i-g/u}{1-e^{(g-ui)T}}\{(1+s)[e^{uiT}-1+v]-(1-r)ve^{gT}\}. \qquad (21)$$

If T is sufficiently short, we can apply the first-order approximation $e^x \approx 1+x$ (for small x), obtaining

$$(y-h)(1+uiT) \approx \frac{1}{uT}\{(1+s)[uiT+v]-(1-r)v(1+gT)\}. \qquad (22)$$

Multiplying both sides by uT, then neglecting quadratic terms in T (which means neglecting the term uiT on the left side),[7] regrouping terms, and solving for y, we obtain Eq. (4) again.

5.2 Perpetual holding

If

$$g < ui \qquad (23)$$

and $T \to \infty$, the exponentials in the general formula [Eq. (18)] approach zero, so that

$$y \approx h + (1+s)(i-g/u). \qquad (24)$$

The condition of convergence [Eq. (23)] implies that the factor $(i-g/u)$ is positive. So the effect of the stamp duty rate s is (again) to increase y and therefore to *reduce* the P/E ratio.

If we neglect the transaction cost s, Eq. (24) reduces to

$$y \approx h + i - g/u, \qquad (25)$$

again confirming that h and i are approximately additive, and agreeing with Eq. (2) if $v = 1$ (i.e. if there is no capital-gains tax, because there is no resale).

If the grossed-up discount rate i is assumed to be exogenous, Eq. (25) indicates that in a rising market (positive g), higher taxation of current income (lower u) gives lower yields, hence a higher risk of financial instability. If, on the contrary, the after-tax discount rate ui is assumed to be exogenous, the situation is less clear, because lower u means higher i.

5.3 No transaction costs

If s and r are negligible, the general formula [Eq. (18)] reduces to

$$y \approx h + \frac{i-\frac{g}{u}}{1-e^{(g-ui)T}}\{1-(1-v)e^{-uiT}-ve^{(g-ui)T}\}. \qquad (26)$$

If $g < ui$ and $T \to \infty$, this reduces to Eq. (25), as it should. If, on the contrary, T is short, we can apply the approximation $e^x \approx 1+x$ to Eq. (26), obtaining

[7] Strictly speaking, the denominator uT on the right side is only a *zero*-order approximation, due to cancellation of the constant term in the corresponding denominator of the previous equation.

$$y \approx h + \frac{1}{uT}\{uiT - vgT\}, \qquad (27)$$

which simplifies to Eq. (2), as it should.

In reducing the general formula to Eq. (26), we have assumed that there are no transaction costs except capital-gains tax. If there is also no capital-gains tax, we can put $v = 1$ in Eq. (26), with the result that all references to T cancel out and we are left with Eq. (25). This is to be expected because, if there were no transaction costs of any kind (not even capital-gains tax), a succession of purchase-resale cycles would seamlessly add up to a perpetual holding, so that the case of a general value of T would agree with the case of the property held in perpetuity.

The independent explanations of some special cases, together with the confirmation of expected relationships between special cases, give cause for confidence in the analysis.

6. Numerical examples

In Table 1, the yield y is computed from the general formula [Eq. (18)]. The top row (beginning with a stamp duty rate of 2%) is the **"base case"**. Subsequent rows show only those figures that differ from the base case. The diagonal line of figures indicates that each of the input parameters in turn is varied from the base case (except that I refrain from varying u, to avoid any assumption as to whether the "exogenous" discount rate is the grossed-up rate i, or the after-tax rate ui, or something in between). The units shown are abbreviated: $h, g, i,$ and y are in %/year, while T and P/E are in years. The last column, $(i + h)/y$, is the ratio of the annual cost of buying to the annual cost of renting, where the "annual cost of buying" excludes principal repayment (the benefit of which is not available to renters). The numbers should be taken as illustrative only.

In the base case, income is taxed at 30% and capital gains at 15%, and the holding charge is 1% per annum. The assumed appreciation rate is 5% per annum, which is modest by (e.g.) Australian standards. Yet the calculated P/E is unrealistically high, even by Australian standards.

If the stamp duty or the resale cost is increased, P/E falls, as is also predicted (albeit for short holding periods) by Eq. (4). If the holding charge h is increased by 1%/year, the fall in P/E is about as large as if the discount rate i is increased by 1%/year; this is to be expected if h and i are approximately additive, as predicted by Eqs. (2), (4), and (25). Increasing the appreciation rate g by 1%/year causes a larger increase in P/E than increasing the holding period to 99 years. Raising the tax on capital gains to match that on current income causes a fall in P/E.

Table 1: Numerical examples computed from the general formula. The first row is the base case. Subsequent rows show figures departing from the base case.

s	r	h	u	v	g	i	T	y	P/E	$(i+h)/y$
2%	2%	1%	70%	85%	5%	8%	10	3.18%	31.45	2.83
3%	.	.	.	.	.	.	.	3.31%	30.17	2.72
.	3%	.	.	.	.	.	.	3.30%	30.32	2.73
.	.	2%	.	.	.	.	.	4.18%	23.92	2.39
.	.	.	.	70%	.	.	.	3.93%	25.44	2.29
.	.	.	.	.	6%	.	.	1.92%	52.12	4.69
.	.	.	.	.	.	9%	.	4.15%	24.07	2.41
.	.	.	.	.	.	.	99	2.07%	48.29	4.35
.	.	.	.	100%	.	.	.	2.43%	41.17	3.71
3%	.	.	.	100%	.	.	.	2.58%	38.82	3.49

Eliminating tax on capital gains (setting $v = 100\%$) causes a rise in P/E. From that point, P/E falls if we increase stamp duty (as in the last line of the table).

In all cases, the last column indicates that buying is considerably more expensive than renting. However, *the affordability of buying is improved by equalizing the tax rates on capital gains and current income, instead of giving concessional rates for capital gains*.

7. Effect of stamp duty

Davidoff & Leigh (2013) have performed a statistical analysis of transaction records to determine the effects of conveyancing stamp duty on housing turnover and "house prices" (that is, prices of house-land packages) in Australia. Concerning prices, they conclude (p. 406):

> Across all postcodes, the short-term impact of a 10 per cent increase in the stamp duty is to lower house prices by 3 per cent...
>
> Because stamp duty averages only 2–4 per cent of the value of the property, these results imply that the economic incidence of the tax is entirely on the seller... Indeed, the house price results are in some sense 'too large', in that they imply a larger reduction in sale prices than the value of the tax (US studies by Ihlanfeldt & Shaughnessy, 2004 and Kopczuk & Munroe, 2012 reach the same conclusion).

According to conventional partial-equilibrium analysis, with an upward-sloping supply curve and a downward-sloping demand curve, a tax imposed between the buyer and the seller reduces the net price received by the seller, but reduces it by *less* than the value of the tax. If we modify the analysis to show how a fixed stock of similar properties will be distributed between current owners and newcomers (Wood et al., 2012:6–7), we again conclude that a stamp duty on the purchaser reduces the price by less than the value of the tax. That is the sense in which the price reductions observed by Davidoff & Leigh are "too large".

The conventional analysis is applied to the purchase or the resale of a property, but not both. If we instead consider the purchase-resale cycle as a whole – as in the present paper – the results of Davidoff & Leigh are easily explained. Any stamp duty on the initial purchase is a deduction from the total interest that a rational investor will pay or forgo during the holding period. It therefore reduces the price that the investor will pay. As the price can be larger than the interest bill during the holding period, the reduction in the price can be larger than the reduction in the interest bill – that is, larger than the stamp-duty bill.

This reasoning is confirmed by Table 1 if we divide s by y to express the stamp-duty bill in years' rent (just as P/E expresses the price in years' rent). Comparing the top two lines, we find that the stamp duty increases by 0.28 years' rent while the price falls by 1.28 years' rent. Comparing the bottom two lines, we find that the stamp duty increases by 0.34 years' rent while the price falls by 2.35 years' rent. In each case, the fall in the price is several times larger than the increase in the duty. Hence, if the duty were offset by a subsidy for home buyers (equivalent to a negative stamp duty), the price would *rise* by more than the value of the subsidy.

8. Stabilizing the market

While we may not know the maximum sustainable P/E ratio, we do know that an infinite price is unsustainable. Hence a reasonable method of assessing the margin of financial stability is to check how far the appreciation rate must rise, or the discount rate must fall, in order to produce a zero yield, i.e. an infinite NPV.

In the base case, the appreciation rate g is 5%/year and the (grossed-up) discount rate i is 8%/year. Using Eq. (18), we find that if the appreciation rate rises to slightly under 7.6%/year or the discount rate falls to slightly over 4.7%/year, the yield y falls to zero. If we repeat the exercise with $v = 100\%$, we find that the yield falls to zero if g rises to about 6.7%/year or i falls to just over 5.5%/year. This example confirms that eliminating capital-gains tax makes it easier to produce infinite NPVs.

If the financial system tries to support unsustainable NPVs, there will be a sub-intrinsic-value bubble. One could try to avoid the bubble by imposing regulatory limits on lending. This policy does not try to restore market efficiency, but tries to change the mechanism by which prices fall short of NPVs – from loans that cannot be repaid, to loans that cannot be made. Because the policy is inevitably less than surgical, it "succeeds" only if some prospective buyers find that their borrowing opportunities are limited by the regulations rather than by their capacity to service loans. In other words, it succeeds only if some people who are financially capable of becoming home owners are "locked out" by the regulations. The experience of the last decade suggests that under those circumstances, the regulations will be either repealed or breached, until the market, having been liberated from the "dead hand" of regulation, collapses under the dead weight of unserviceable debt.

Given a model predicting the effects of taxes on NPVs, there is an alternative remedy which *does* restore market efficiency, namely to reform the tax system so that NPVs are brought within the borrowing capacity of prospective buyers.

From the base case, let us change s to 0 (no stamp duty) and v to 55% (45% tax on capital gains). Then P/E falls to a more sustainable 22.4 years, and $(i+h)/y$ (the ratio of the annual cost of buying to the annual cost of renting) falls to 2.02 (lower than any example in Table 1). To reach an infinite NPV from this new starting point, g must rise to almost 10%/year or i must fall to just over 3%/year. So this tax regime not only makes home ownership more affordable but also makes financial stability more robust in the face of changing parameters.

From the base case again, let us change s to 0 (again) and v to 100% (no tax on capital gains), and raise the holding charge h to 3.33%/year. Then P/E falls to 22.4 years (again), indicating that the tax system raises the same revenue (in discounted terms) over the purchase-resale cycle as in the previous example. But $(i+h)/y$ falls only to 2.54, indicating that the annualized cost of buying is higher than in the previous example. This is to be expected because the tax is payable continuously through the holding period, not as a lump-sum on resale. Financial stability, although more robust than in the base case, is less robust than in the previous example: the calculated P/E becomes infinite if g rises to about 8.2%/year or i falls to about 3.5%/year. So in this example, a capital-gains tax does more for housing affordability and financial stability than a holding charge (e.g. a land tax) raising comparable revenue.

Stamp duty, like capital gains tax, is a deduction from the interest that a rational investor will pay during the holding period; but, unlike capital gains tax or interest, it is not roughly proportional to the holding time. Hence, while both stamp duty and capital-gains tax depress prices, the impact of stamp duty is more sensitive to the holding period T. For example, if we modify the base case so that there are no transaction costs of any kind (stamp duty, resale costs, or capital-gains tax), the predicted P/E ratio is an absurdly high 53.85, regardless of T. If T is 4 years, a 45% capital-gains tax or an 8% stamp duty reduces P/E to about 21.1. Under the capital-gains tax, halving T reduces P/E only slightly further, to 20.4; but under the stamp duty, halving T reduces P/E to 13.1. So, for the purpose of stabilizing the market, capital-gains tax is preferable in that its effect is less sensitive to the intended holding period.

9. Effects omitted from the model

The above comparison between a capital-gains tax and a holding charge assumes that the latter is "payable continuously through the holding period." If payment of the holding charge were instead deferred until the next sale of the property, the charge would resemble a capital-gains tax in the timing of the payment, and in the amount paid (because both the cumulative holding charge and the capital gain would increase with *T*).

The discount rate (or some measure of it) and the appreciation rate are treated as exogenous in this paper, although in practice they must be influenced to some extent by tax policy. Most obviously, any mismatch between tax rates and spending commitments may influence the government borrowing requirement, which in turn will have some influence (among other influences) on expected interest rates, hence discount rates. Less obviously, if a government, by means of a land tax or a capital-gains tax, stands to gain revenue from uplifts in property values, it has an incentive to invest in infrastructure projects that cause such uplifts in the serviced locations. If the tax base is reformed so that the government receives a

larger share of such uplifts, a wider range of projects will pay for themselves by expanding the tax base (with no further increase in tax rates), so that more projects will proceed per unit time, and g will be greater.

The rental value of a property is also treated as exogenous, although it must be influenced to some extent by tax policy. For example:

> (a) Stamp duty, unlike land tax, impedes transfers of title. In particular, stamp duty impedes transfers that are needed for construction of new accommodation. This mechanism tends to reduce the supply of accommodation, making rents less affordable (that is, raising rents relative to amenity and tenants' spending power). Capital-gains tax is open to the same criticism, but not to the same degree, because (i) under a stamp duty, the transfer of title *creates* a tax liability, whereas under a capital-gains tax it merely *realizes* an already accumulated liability, and (ii) a capital-gains tax, unlike a stamp duty on the purchase price, will not turn a capital gain into a capital loss or increase a capital loss.
>
> (b) Proponents of land tax argue that a holding charge on the land presses the owner to generate income from it, in order to cover the holding cost, and therefore encourages construction, raising the supply of accommodation and making rents more affordable. (If, however, the holding charge is levied not on the land value alone, but on the combined value of the land and artificial structures, the incentive to build will be reduced.) A capital gains tax, by reducing the attractiveness of capital gains relative to current income, also encourages land owners to generate income from their land; but because the tax is not a holding cost, the need to generate income is less urgent than in the case of a land tax.

While the numerical examples tend to favour capital-gains tax over land tax, the above points, which are not so easily quantified, tend the other way.

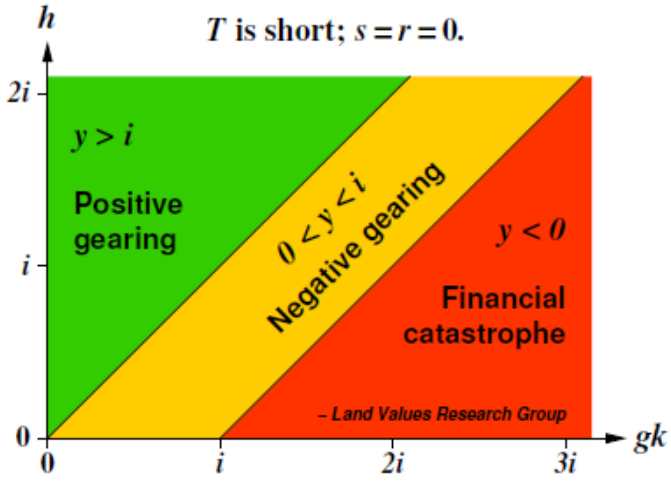

Fig. 1: Financial stability contour map for short holding times, and no transaction costs except capital-gains tax. The "map" is a graph of the equilibrium rental yield y as a function of the holding tax rate h (vertical axis) and the gk product (horizontal axis), where g is the appreciation rate and k is the effective capital-gain magnification due to income tax.

If tax parameters influence market parameters (other than y), we cannot arbitrarily change the former while assuming that the latter stay the same. This observation does not invalidate the general formula, but does affect the values that should be substituted into it.

10. Financial stability contour map

Using a two-dimensional contour map, we can graph the calculated yield y as a function of any two parameters (or combinations of parameters) while other parameters are held constant. Two interesting contours are $y = i$ and $y = 0$. These delineate three regions in which (respectively) $y > i$, $0 < y < i$, and $y < 0$. The last region can be labeled "financial catastrophe" without implying that it can ever be reached; in practice, financial crises begin when the actual rental yield is still positive, albeit low. The region $0 < y < i$ can be labeled "negative gearing" after the Australian term for a cash-flow-negative investment (as if the entire purchase price is borrowed at the interest rate i, which exceeds the yield). Obviously a "negatively geared" investor relies on capital gains and/or rising rents. The region $y > i$ can then be labeled "positive gearing" (if we ignore holding costs other than interest).

One example may suffice for illustration. If T is short and there are no transaction costs except capital-gains tax, we can apply Eq. (2), which can be written

$$y \approx h + i - gk, \tag{28}$$

where $k = v/u$ is the factor by which the tax system magnifies capital gains relative to current income. Eq. (28) can be understood as expressing y as a function of h and gk. To graph the function, we can calibrate the axes in terms of i. Because the "function" is linear, the contour map will be that of a sloping plane, so that the contours will be uniformly spaced, parallel lines.

To find the contours, we solve for gk, obtaining

$$gk = h + i - y. \tag{29}$$

A single contour is a graph of gk vs. h for constant y. This graph is a straight line with unit slope and an intercept of $i - y$ on the gk axis. For the contour $= 0$, the intercept is i; and for the contour $y = i$, the intercept is 0. The result is shown in Fig. 1, from which we can easily see that stability is improved as we move up or to the left – that is, as we increase the holding charge or reduce the effective capital-gain magnification (that is, raise the capital-gains tax).

11. Conclusions

There are combinations of tax rates, appreciation rates, and discount rates under which net present values (NPVs) of properties will exceed buyers' capacity to service loans. If the financial system tries to support such high prices, borrowers will be overextended, causing a financial crisis, which will be said to have been unforeseeable because prices remained below NPVs.

The sovereign remedy for this sort of financial instability is to change the tax settings so as to bring NPVs within buyers' capacity to service loans, allowing the market to be efficient. This can be done by raising recurrent property taxes (preferably levied on land values alone) or capital-gains taxes. In the absence of deferrals of recurrent property taxes, the capital-gains-tax option does more to reduce the annual cost of ownership relative to renting.

A general consumption tax, whatever its rate may be, does not affect P/E ratios in so far as it merely devalues the currency in which prices and rents are measured. Nor does this paper assume anything about the tax on *labor* income. Both of these taxes can be raised or lowered without affecting the parameters of this paper. Thus the "sovereign remedy" has no implications concerning the overall level of taxation or public expenditure.

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On the Historical, Moral and Economic Arguments for Asymmetric Trading Regimes: the case of sub-Saharan Africa[1,2]

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Abstract

The Least Developed Countries Report 2006 argued that a paradigm shift in national and international policies to promote development and poverty reduction is required because current policies are inadequate and have failed to develop productive capacities in the underdeveloped economies. However, the policies that are advocated do not deal with the fundamental question of how the new paradigm should differ in its approach to trading regimes currently in operation. In this paper we address this in terms of the arguments against the comparative advantage orthodoxy of free trade and for the acceptance of an asymmetric trading regime for sub-Saharan Africa based on the history of economic development and the underlying moral imperative.

Keywords: international trade, trade policy, trade history, economic development

1. Introduction

The neo-classical free trade paradigm, coupled with the model of comparative advantage, undergird the structural adjustment programs imposed by International Financial Institutions. The resulting exposure to international markets suggests that export promotion will lead to increased efficiency among domestic firms which can then better compete in international markets while exposing domestic markets to imports will have the same effect (Milward, 2003:116). However the underlying comparative advantage model only generates mutually beneficial outcomes if the assumptions hold. But these assumptions radically misrepresent the contemporary modern international economy. Thus these models are not general, they are instead a special case (cf *ibid*:120).[3]

The argument countering the free trade narrative sakes as a starting point the view that when economies at different levels of GDP engage in free trade there are unequal outcomes which increase global inequality (see Arghiri Emmanuel, 1972; Immanuel Wallerstein, 1989; and Samir Amin, 1980).

Analyses of international trade build on unequal exchange shows how the superior "competitive" strength of the developed economies subjugates the less developed economies sufficiently to ensure exploitative international trading relations. Recognizing this exploitation supports an important moral argument against free trade. In its place economists should argue that asymmetric trading regimes are better suited to an international economy characterised by inequalities of income, wealth and power (cf Baiman, 2006).

Even Paul A. Samuelson recanted his earlier position vis-à-vis the mutually beneficial outcomes of free trade and adopted the position that free trade exacerbates the unequal gains from trade. [Samuelson, 2004]. In addition, Schumacher (2013) seriously calls into question the validity of the assumptions that underpin the model of comparative advantage, and suggests that the model itself is 'wrong in its own terms' (p99).

Standard neoclassical histories of trade periodize capitalism in terms of a series of waves. The first

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British industrial revolution (18th century) bleeds into the next wave occurring in second half of the 19th century in the United States, Continental Europe and Japan. The third wave includes the post WWII reconstruction of Europe and Japan after the Second World War while the fourth wave extends to the so-called Asian NIC's in the late 1960s and 1970s.[4]

Despite countless gallons of neoclassical ink to the contrary, there is no evidence that any of these phases of economic development took place under a regime of free trade. Still the International Financial Institutions of the World Bank, The International Monetary Fund and the World Trade Organisation insist that contemporary underdeveloped economies engage in free trade. This policy approach is unjustified on historical, moral and economic grounds. The G7/G8 advances the same neo-liberal economic and social policies. Their arguments boil down *TINA*: **T**here **I**s **N**o **A**lternative to free market capitalism and western-style "democracy" (Milward, 2003:16). Thus it's important to show that alternatives to the current orthodox trade theory do exist and that such alternatives have sound bases in economic theory, are of greater moral repute, and rooted in the history of global capitalism.

These pre-requisites are presented here as arguments supporting of asymmetric trade resulting in mutually beneficial international exchanges. This argument directly contradicts the model of comparative advantage. The fundamental idea is that if the contemporary rich nations would continue to pursue free trade in their domestic markets, while accepting protectionism among and for the sub-Saharan economies the latter will see processes of economic growth which actually increase the living standards of the population. One cannot help but notice the irony – today's richest nations deny the efficacy of protectionism even though that is exactly the policy route they pursued to achieve their current economic status.

The argument is that in none of the earlier waves of industrialisation were based on regime of free trade. Successful national capitalist economic development requires protectionism. That is, nations attempting to develop need protectionist policies while the already rich nations continue to pursue free trade. Erecting retaliatory trade barriers in response would negate any possible economic gains from the protection and reduce the volume of world trade.

But why should the already developed economies restrict their own trade and reject the neo-liberal orthodoxy that cements their global economic hegemony?

2. Summary of Literature

The International Financial Institution's (IFI's) accept the neo-classical free trade model (e.g., the Heckscher-Ohlin-Samuelson HOS model) and base their policy prescriptions on it. They argue that exposure to competitive international markets – no tariff barriers, quotas or other obstacles to trade – means that all countries benefit directly from the flow of the more efficiently produced imports and indirectly through exports priced to compete in international markets.

Microeconomic studies suggest that trade liberalisation leads directly to more competition and thus improved economic performance. Using panel data from 96 nations, Hur *et al* (2010) found that free trade agreements doubled the volume of exports and so induced a positive impact on economic growth. However, other, similar studies have uncovered more ambiguous outcomes of the implementation of free trade policies. One study using data from 37 underdeveloped countries in the medium to long run found little evidence of improved food availability (Bezuneh & Yiheyis, 2014). Another suggests that trade liberalisation did not reduce poverty or inequality in Pakistan study (Chaudhry & Imran, 2013). A third study utilizing data from 26 African nations found only minimal effects on income (Batu & Asongu, 2015).

Numerous studies highlight the disastrous effects of free trade on a variety of economic variables. Englebert and Hoffman (1996), in a study of pre-reform Burundi in comparison to the period of structural adjustment, concluded that the impact of trade reform was limited. In a similar investigation, Swamy (1996) found no signs of improvement as a result of trade liberalisation in Kenya. These adverse results are not however confined to sub Saharan Africa. Galiani and Porto (2006) show how trade liberalisation in Argentina reduced wages and increased wage inequality. Green (1995) noted that Mexico's trade reform generated large trade deficits because consumer imports increased. Chisari *et al* (1996) found the same trade results for Argentina, where a trade surplus became a trade deficit.

Epstein *et al* observe, over the period 1950-1998, that, 'in the long term the established trade patterns favoured the growth of the rich at the expense of the poor economies across the world' (Epstein, et.al. 2007:101). These findings suggest that the existing trading relations do not lead to global income convergence (in the case of 155 countries studied) as the Hecksher-Ohlin-Samuelson model of comparative advantage suggests. To the contrary, it's widened the income gap.

Kee *et al* (2006) in constructing trade restrictive indices have argued that although poor countries are inclined to have more restrictive trade regimes, they tend to face higher barriers on their exports. This is exacerbated further for the low income primary producers as their overall trade restrictiveness index suggests that trade on a global basis faces restrictiveness of 15 per cent, but the figure for agriculture reaches 41 per cent. They also note that non-tariff barriers contribute approximately 70 per cent on average to trade restrictiveness.

Islam *et al* (2014) investigated the role of trade liberalisation in changing the trade pattern among South Asian countries in the South Asian Free Trade Agreement and found no empirical evidence of trade creation, whilst there was a substantial increase in exports from these countries.

Skarstein (2007) suggests that poor countries do not have a comparative advantage in agricultural goods. They have an absolute disadvantage in the trade of both agricultural and industrial goods so trade liberalisation harms the poorest countries.

Also of interest are Rönnbäck's findings (2015). Analysing the political influence of lobbying groups he found that interest groups are generally anti-protectionist and that they lobby western governments for trade liberalisation. The motive for this appears to be the value of gaining access to foreign markets.

3. The Extent of the Problem in Sub-Saharan Africa

The UNDP (2013) reports that the 25% of the world's population living in high-income nations receive 77% of the world's income. This helps explain why each and every cow in the EU receives a subsidy worth $2 per day (Oxfam 2002) at the same time that 1.44 billion people live on incomes at or below $1.25 per day. The 60% of the world's population in low-income countries receive only 6 per cent of world income. Of these world's 7 billion people, 4.8 billion live in low-income countries, of these 464.8 million live in sub-Saharan Africa.

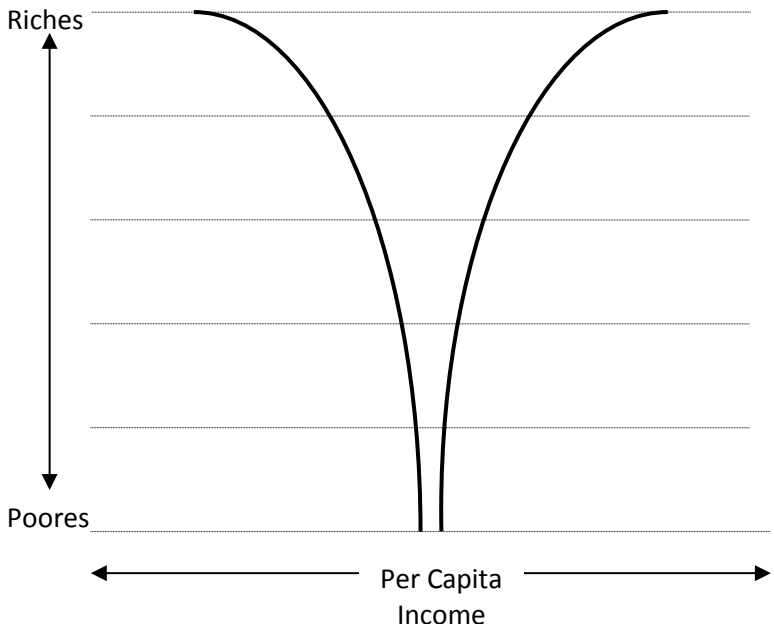


Figure 1: World Income Distributed by Percentiles of the Population

Source: Dikhanov,Y. (2005), 'Trends in global income distribution 1970-2000 and scenarios for 2015', *Human Development Report Office Occasional Paper*, New York, UNDP

Dikhanov (2005) suggests that global income distribution resembles a champagne glass as illustrated in Figure 1. Where the glass is at its widest point, the richest 20 per cent of the population hold 75 per cent of world income. At the bottom of the stem, the poorest 40 per cent hold 5 per cent of world income and the poorest 20 per cent hold just 1.4 per cent.

Since 1995 the development gap between the richest and the poorest countries has gotten wider. For example, in 1998 the average US citizen was 18.6 times richer than the average citizen of Côte d'Ivoire; in 2012, the average US citizen was 26.9 times richer. To put this into perspective, India has had relatively high rates of growth (2004-2010 8.6 per cent average), but will still take until 2106 to catch up with the high-income countries if the trend continues. If the high income countries were to stop growing today and Latin America and sub-Saharan Africa were to continue on their current growth trajectories, it would take Latin America until 2177 and sub-Saharan Africa until 2236 just to catch up. However, most underdeveloped countries are actually falling further behind. Because the absolute income inequalities between the rich and the poor countries are increasing even when underdeveloped countries have higher growth rates. For example, if average incomes grow by 3 per cent in both sub-Saharan Africa and Europe then the absolute change would be an extra $854 per person in Europe and but only an additional $51 in Africa.

Table 2: Human Development Index Trends: Sub-Saharan Africa Low Human Development 1975-2012

	1975	**1980**	**1985**	**1990**	**1995**	**2000**	**2003**	**2012**
Angola	..	..	..	..	..	.403	.445	.508
Benin	0.304	0.366	0.362	0.368	0.395	0.422	0.431	0.436
Burkina Faso	0.253	0.273	0.297	0.305	0.311	0.328	0.317	0.343
Burundi	0.285	0.311	0.345	0.353	0.324	0.313	0.378	0.355
Cameroon	0.416	0.463	0.505	0.514	0.494	0.500	0.497	0.495
Central African Republic	0.343	0.364	0.386	0.383	0.367	0.375	0.355	0.352
Chad	0.269	0.271	0.311	0.335	0.344	0.359	0.341	0.340
Congo	0.452	0.499	0.540	0.526	0.531	..	0.512	0.534
Congo. Dem Rep	0.414	0.423	0.431	0.422	0.393	0.431	0.385	0.534
Côte d'Ivoire	0.409	0.441	0.448	0.442	0.427	0.428	0.420	0.432
Djibouti	..	..	..	..	0.477	0.487	0.495	0.445
Eritrea	..	..	..	..	0.409	0.428	0.444	0.351
Ethiopia	..	..	0.291	0.311	0.323	0.352	0.367	0.396
Gambia	0.284	..	..	..	0.375	0.405	0.470	0.439
Ghana	0.438	0.467	0.482	0.511	0.531	0.555	0.532	0.558
Guinea	..	..	..	..	..	0.414	0.466	0.355
Guinea-Bissau	0.255	0.262	0.283	0.313	0.341	0.353	0.348	0.364
Kenya	0.461	0.509	0.530	0.546	0.524	0.499	0.474	0.519
Lesotho	0.461	0.510	0.534	0.571	0.573	0.520	0.497	0.461
Madagascar	0.400	0.437	0.436	0.446	0.458	0.469	0.499	0.483
Malawi	0.320	0.351	0.362	0.371	0.412	0.402	0.404	0.418
Mali	0.230	0.256	0.263	0.283	0.307	0.330	0.333	0.344
Mauritania	0.340	0.363	0.384	0.388	0.424	0.444	0.477	0.467
Mozambique	..	0.299	0.287	0.311	0.328	0.360	0.379	0.327
Niger	0.236	0.252	0.242	0.249	0.256	0.271	0.281	0.304
Nigeria	0.318	0.376	0.386	0.406	0.418	0.462	0.453	0.471
Rwanda	0.342	0.388	0.401	0.340	0.355	0.435	0.450	0.434
Senegal	0.311	0.339	0.375	0.403	0.421	0.444	0.458	0.470
Sierra Leone	..	..	..	..	..	0.275	0.298	0.359
Sudan	0.349	0.376	0.396	0.428	0.465	0.500	0.512	0.414
Swaziland	0.530	0.562	0.584	0.624	0.603	0.534	0.498	0.536
Tanzania	..	..	..	0.435	0.422	0.416	0.418	0.476
Togo	0.423	0.475	0.474	0.500	0.510	0.519	0.512	0.459
Uganda	..	..	0.412	0.409	0.412	0.474	0.508	0.456
Zambia	0.468	0.475	0.484	0.462	0.424	0.409	0.394	0.448
Zimbabwe	0.546	0.574	0.640	0.637	0.589	0.527	0.505	0.397

Source: UNDP *Human Development Reports Various Issues*, New York, United Nations

Table 2 illustrates that for most countries in sub-Saharan Africa development over a period of 37 years has been minimal, but for 23 countries this has included regression from a previous level of development, as represented by the HDI. Indeed, Central African Republic, Congo, Côte d'Ivoire, Zambia and Zimbabwe all have a lower HDI in 2012 than they did in 1985. Others such as Cameroon, Kenya, and Swaziland have seen regression since 1990.

Table 3 GDP per capita and Life Expectancy in Selected sub-Saharan Low Development Countries 1986-2012

	GDP per capita (PPP US$)				**Life Expectancy at Birth**		
	1998[a]	**2003[b]**	**2011[c]**		**1998[a]**	**2003[b]**	**2012[c]**
Burkina Faso	870	1,174	1,149		45	48	56
Burundi	..	648	533		43	44	51
Cameroon	1,478	2,118	2,090		55	46	52
Central African Republic	1,126	1,089	716		45	39	49
Congo. Dem Rep	825	697	329		51	43	49
Côte d'Ivoire	1,585	1,476	1,581		53	46	56
Eritrea	835	849	516		51	54	62
Ghana	1,735	2,240	1,652		60	57	65
Guinea	..	2,097	990		47	54	55
Lesotho	1,637	2,561	1,504		55	36	49
Mali	684	994	964		54	48	52
Mozambique	784	1,117	861		44	42	51
Niger	741	835	642		49	44	55
Rwanda	662	1,268	1,097		41	44	56
Sudan	1,392	1,910	1,878		55	56	62
Swaziland	3,876	4,726	5,349		61	33	49
Togo	1,377	1,696	914		49	54	58
Uganda	1,075	1,457	1,188		41	47	55
Zimbabwe	2,675	2,443	..		44	37	53

[a] Human Development Report 2000

[b] Human Development Report 2005

[c] Human Development Report 2013

This translates into economic and quality of life statistics, as illustrated in table 3 where four countries have seen their life expectancy fall in the period 1998 to 2012.

Similar results pertain to GDP per capita (18 countries recording falling per capita income). Therefore, given that these economies have been subjected to the conditionality imposed by the International Financial Institutions (free trade, free markets and 'good governance'), such policies have not led to development. They have, in fact, often resulted in social and economic regression.

4. The Moral Argument

The moral argument arises from the idea that we share a common humanity and if it is in our power to assist other human beings out of abject poverty, without risking our own position, then morally we ought to do it. This is even more true because free trade is insisted upon for the underdeveloped economies while the advanced countries maintain protective measures. This suggests that in practice protectionism that faces free trade results in economic gains for the protected economies. These gains are at the expense of the economies that practice free trade hence the term 'unequal exchange'. Indeed, even when economies at different levels of development trade freely, the processes of unequal exchange ensure enrichment of the more developed and the impoverishment of the less developed.

Thus development economists must confront the idea that it is not merely irrational, but also immoral (or at least inhumane) to fail to replace a system whose inefficiency, or sub-optimal productivity, prevents important human potentials from being realised. There is another important connection between efficiency and the morality of the free market. Consider the possibility that the civil and political-legal rights that individuals enjoy in capitalism are valuable because they are ways of coping with types of conflicts that are produced by the capitalist system. Thus basic civil and political rights (as well as distributive rights to a share in material wealth) are necessary and valuable only where there is the egoism created by capitalism's class divisions.

Such arguments alone cannot make the moral case against the free market. As Nozick has argued, the market and the market alone avoids violations of 'moral rights'. A very broad right to private property, including private property in the means of production, is for Nozick, morally fundamental and determines both the most basic principles of individual conduct and the legitimate role of the state. Therefore, value judgements determine what is morally 'good' and what is morally 'bad' (Nozick, 1988).

Such value judgements are based on the theoretical and practical arguments surrounding particular phenomena. Hence it is incumbent on the author to demonstrate why a particular course of action, or a particular policy, constitutes an immoral or unethical point of view. Here the argument is based on the historical, theoretical and empirical case against the imposition of free trade on economies at an early stage of industrial development.

The teleological argument follows Singer's: since suffering and death are bad when it is in our power to prevent the bad from happening without requiring a comparable sacrifice, then morally we ought to do it. Rich countries *can* do something to reduce the number of starving people in the world without giving up basic necessities. It follows that if free trade contributes to poverty in underdeveloped economies, then such policies should be abandoned in favour policies to alleviate that poverty, even if this comes at a price to the economies of the rich countries. Hence poverty relief via appropriate trade policies is a moral obligation arising from our common humanity.

Benn (1988) argues that there is a deontological argument in the form of the *principle of respect for persons*. This encompasses Value Centred principles that are concerned with a person's ultimate welfare and Person Centred principles concerning an individual's rights. Thus, respect is due to all other persons, which represents a minimal condition for moral relations between persons rather than an ideal. It follows therefore, that it is an obligation of humanity to provide a minimum welfare floor for all individuals, irrespective of the nation state into which they were born. If it is in the power of some to provide the minimum for others, then this is a morally correct course of action to take.

Hence if it can be demonstrated that current free trade policies actually make the situation worse for the citizens of the low income nations, then those policies are immoral.

Moral considerations of intervention on an international scale also tend to follow the common framework of humanitarian obligation. However, Wesley has suggested that a set of moral issues is required that address realist considerations. Hence, political action is pursued within a common moral community and therefore, political leaders have the moral obligation to advance the interests of their own bounded moral communities. In such a realist system of morals then three principles apply; first, the motivation is in accordance with the state's own interest; second, this is justified in terms of the principles of legitimate action and third, it is validated by reference to the principles of international order (Wesley, 2005:56). However, the realist approach has far too great a concentration on the needs of the 'haves' and too little attention is focused on the needs of the 'have nots'. Indeed, the major consideration is the justification of the nation states position *vis-à-vis* the moral considerations of its residents.

Models of economic justice recognise the difference between individual moral positions and how those should be translated into a collective moral position. Kapstein argues that there are essentially three models of economic justice; first, the communitarian model reflects concern with the effects of global pressures on domestic economies, consideration of who are the winners and losers from internationalisation in terms of the distribution of resources and the ability of domestic economies to maintain their fiscal and social policies. Second, The Liberal International model focuses on the consequences for the international community and the influence on income distribution between countries. In particular it asks the question how

trade, aid and investment should be used to promote economic development and income convergence. Third, the cosmopolitan model which is concerned with the effects of the prevailing international economic structure on the well-being of persons. Concentration within this model on the poor and disadvantaged is promoted by the prioritarian cosmopolitans, whereby the international arrangements should be reformed such that they do not promote shortfalls from minimum living standards, and reform of the international economic structure should concentrate on meeting the basic needs of the poor and the least advantaged (Kapstein, 2004:81-82). Thus this approach draws on Rawls' *maximin rule* where consideration must be focused on the position of the least advantaged. Translating this into an international context then in the Rawlsian original state, nation states bargaining for resources do so behind a 'veil of ignorance' in that they do not have knowledge of their own resource position. According to Beitz, there is no prior moral claim by states to the resources that are located on their constituency and therefore, the pattern of inequality that results from an international system will be unjust if that arrangement fails to incorporate a resource redistribution principle (Beitz, 1979).

A significant contribution to this debate is Pogge's book *World Poverty and Human Rights* (2002), in which he contends that developed countries have obligations to end world poverty through a causal contribution principle. Pogge concentrates on the ways in which governments of the affluent countries impose an international economic order on the underdeveloped economies. Emphasising the philosophical arguments, he argues that the concepts of 'harm' and 'cause' suggest that we invoke a benchmark to which the situation can be compared. That is, a subjunctive comparison between the actual position of global poverty and that which would have arisen in the absence of the causal factors. For Pogge, the benchmark is generated by the burdens imposed by the World Trade Organisation (WTO) in particular, and by the Bretton Woods Institutions in general. Thus, the question of whether global poverty has been caused by a regime of free trade depends on whether poverty would have been as great under a *just* alternative set of international trade rules.

Pogge shows that the libertarian view (in which the affluent are neither individually nor collectively responsible for harming the world's poor by causing their poverty), is not a credible argument. Rather, the 'need-based' view has much greater credence. That is, the neediness of the global poor establishes an extensive set of duties to assist them since the obligation of assistance prevails–there are therefore 'positive' human rights, including a right to have one's basic needs fulfilled.

Therefore, if it can be shown that the existing international order is indeed making the situation for the poor worse, and that there is an alternative order that could reverse the situation, then the developed countries have an obligation to introduce the alternative international order.

Hence, it follows that if free trade were to lead to economic convergence, then the initial resource inequalities would be overcome (as in the Hecksher-Ohlin-Samuelson factor endowment version of comparative advantage). However, as suggested by the arguments of unequal exchange/unequal specialisation, convergence is not the outcome. Indeed, such models appear to explain the observed *divergence* that has occurred between the developed and the underdeveloped nations.

If we then accept both the ethical the position that humanitarian obligations exist, and the cosmopolitan theory of economic justice, then if we find that the existing Washington consensus causes increasing inequality we are morally obliged to introduce the alternative system.

5. Economic Arguments

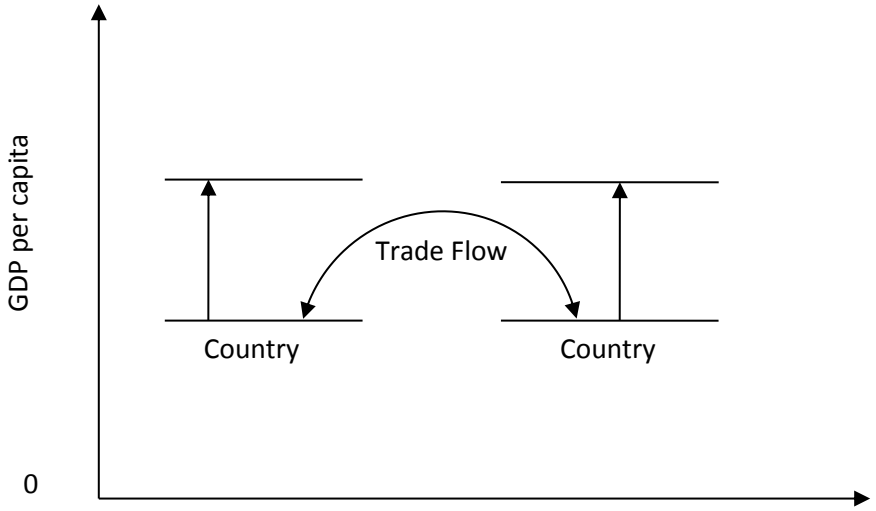
The UNCTAD Report of 1999 argues that protectionism by the rich countries has hindered the exports of the poor countries, forcing the latter to rely on excessively footloose, short-term capital to finance their growing trade deficits. Trade liberalisation it argues has, in a quarter of a century, led to rising trade deficits for the poorest countries. In addition, underdeveloped countries grew more slowly in the 1990s than in the 1970s, whilst they were unable to increase their exports due to slow growth in the industrialised economies and their insistence on protectionism. The report calculated that the poorest countries could earn approximately $700 billion per annum in low technology manufactures if the rich countries were to dismantle their trade barriers – this is equal to four times the level of capital flows in the 1990s.

The Least Developed Countries Report of 2006 argues that since the late 1980s the majority of underdeveloped economies have implemented reforms that have involved privatisation, liberalisation and macroeconomic stabilisation. These have occurred under the umbrella of structural adjustment programmes proscribed by the 'Washington Consensus' (UNCTAD, 2006:286). Since 2000 a second generation of reforms have been undertaken under the general approach of poverty reduction strategies, which were supposed to facilitate a more nationally-owned set of economic and political reforms.

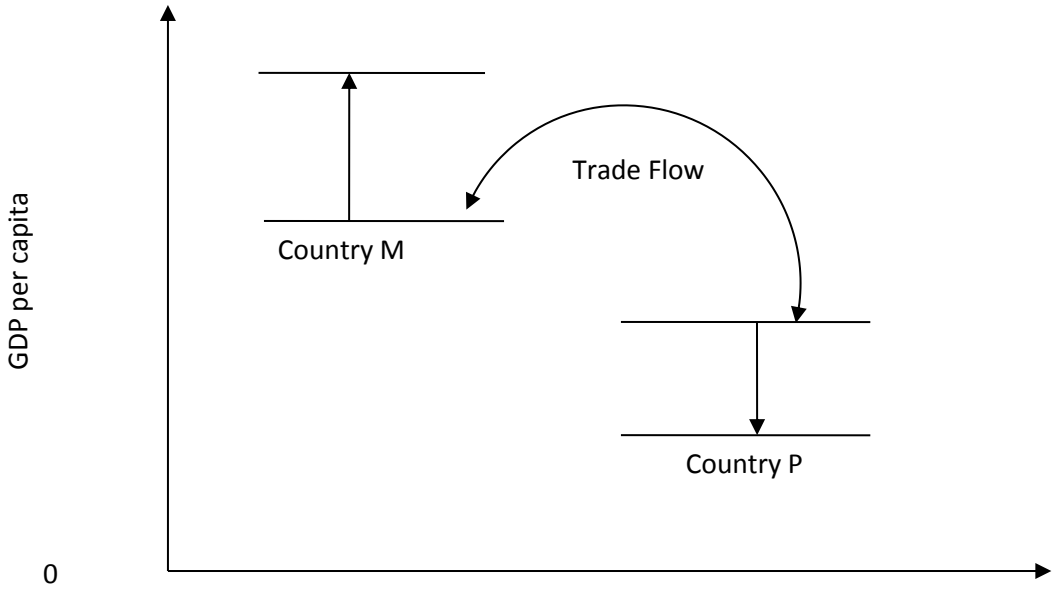
Even the World Bank has conceded that the outcomes of the first generation reforms were 'less than expected' and the move to the second generation reforms was, 'as a result of the disappointing supply response to first generation reforms' (World Bank, 2004:12). There exists a view that the first generation reforms failed due to a lack of proper implementation. However, this would appear to be unrealistic given the extent of policy reform that has taken place and a more realistic appraisal would suggest that the design of the reforms was at fault.

Figure 2 Effects of Free trade Between Nations Based on GDP per capita:

(i) Free trade between economies at similar levels of GDP



(ii) Effects of Free trade between economies at different levels of GDP



One alternative that is already in extensive use is the Preferential Trade scheme. Agreements on preferential trade have proliferated rapidly such that the number of agreements is now greater than WTO members and the trend is continuing apace. Indeed, by 2004 there were 229 preferential trade agreements in place between 174 countries with on average at least five agreements per country (Medvedev, 2006:47). However, it is argued that preferential trade does not account for a large share of world trade, actually amounting to only just under a third of the global total in the period 2000-2002 (*ibid*). Even this figure may be an overestimate as unilateral and multilateral liberalisation has led to tariff lines with zero, or low, Most Favoured Nation duties. This suggests that in these cases the margin of preference for PTA members is relatively insignificant leading to the under-utilisation of preferences and that the 'true' level of preferential trade is between one-tenth and one-sixth of the total of world trade. Within this, at a regional level, the majority of preferential trade is implemented by countries in Eastern Europe and Latin America while countries in East Asia have low preferential trade shares (*ibid*:48).

Manchin (2005) illustrates how the preference scheme operated by the EU has an inbuilt bias against the request for preferential tariff rates as the preference margin (the difference between third country and preferential tariffs) does not provide sufficient incentive for preferences to be requested. In addition, there are shown to be sectoral differences in the request for preferential access reflecting, production costs, the quality of the products, the level of competitiveness, the infrastructure and institutional qualities.[5]

Brenton and Hoppe (2005) examine the trade preferences involved in the US African Growth and Opportunity Act and their impact on Sub-Saharan Africa and find that export diversification is stimulated in only a few cases. Trade preferences extended to all products under the scheme would enhance its impact particularly as this would require the removal of tariff barriers to a range of agricultural products, textiles and a wider range of manufactured goods.

6. Thus, replicating the arguments of the Linder thesis (Linder, 1961)

In addition, Stern and Deardorff (2006) recommend that there is a strong likelihood that non-participants in trade liberalisation will lose out to those countries that do participate. In addition, preferential liberalisation has tended to divert trade from the excluded countries causing their terms of trade to worsen. Hoekman and Prowse (2005) suggest that because many underdeveloped economies cannot take advantage of trade preference programmes then preference erosion should be the response allied to the introduction of a trading system than is more supportive of economic development.

Hoekman and Özden (2005) conclude that the Special and Differential Treatment (SDT) for underdeveloped economies under the GATT/WTO agreements has not delivered what was intended, due to the limited benefits that have had a skewed distributional effect, and have only been obtained at a high cost to the trading system and to donor country consumers. The outcome has been only a marginal benefit to the underdeveloped economies. "[W]hat determines and drives performance is not what others do, but what countries do for themselves" (Hoekman & Özden, 2005:38). Hence, the idea that trade preferences could be used as aid needs to be revised towards a more transparent set of non-discriminatory trade policies. This would require a commitment by the developed countries (triad) to longer term resource shifts towards the poor economies, suggesting that greater development assistance would be both more efficient and more effective.

Somel (2004) has argued that the macroeconomic assessment of globalisation presented questions the validity of the argument that global commodity/value chain analysis represents a new perspective on the theory of development. In particular, such an analysis implies equal rates of capital accumulation in a North-South model and a stable ratio in incomes in the long-term. This proposition is shown to be untenable as the exports of the south must be aimed at markets in the north which are controlled by Northern-based multi-national companies (MNCs). Hence, this questions the judiciousness of strategies of export-led growth as the major policy instrument in a development strategy for underdeveloped economies. This, it is argued, would entail the fallacy of composition as efforts to raise productivity in underdeveloped economies would lead them to deliver better quality goods at lower prices, but would not alter significantly the power relations between the Northern MNCs and the Southern producers. Hence, it recommends that underdeveloped

economies should improve their positions in commodity chains to reduce their dependence on export earnings; in conjunction with an effort on the part of the international community (the triad) to reform trade structures that at present favour the MNCs over the underdeveloped economies.

Murphy notes that in 2000, Congress passed the Trade and Development Act which incorporates the African Growth and Opportunity Act, which was designed to reduce or eliminate US quotas and tariffs on goods from 48 sub-Saharan countries. In 2002, President Bush signed into law a trade promotion authority act that provides the President with the authority to negotiate trade agreements that could then be submitted to both houses for a majority vote (Murphy, 2002:979-80). Both pieces of legislation are designed to promote free trade relationships, but could equally be employed in the initiation of asymmetric trading relationships. However, in 2011 US imports from sub-Saharan Africa were $74 billion, representing 3.4 per cent of total US imports of $2.2 trillion. The US exported $20.3 billion to the region (1.5 per cent of total US exports. In addition, this trade was dominated by only three countries, Nigeria, Angola and South Africa, with US imports dominated by primary products.US FDI in Africa amounts to one per cent of total US FDI with South Africa receiving 63 per cent of the investment. The outflow of US FDI to sub-Saharan Africa in 2011 ($3.4 billion) was only one-third greater than the inflows of FDI to the US from the region ($2.1 billion) (Jones & Williams, 2012:7).

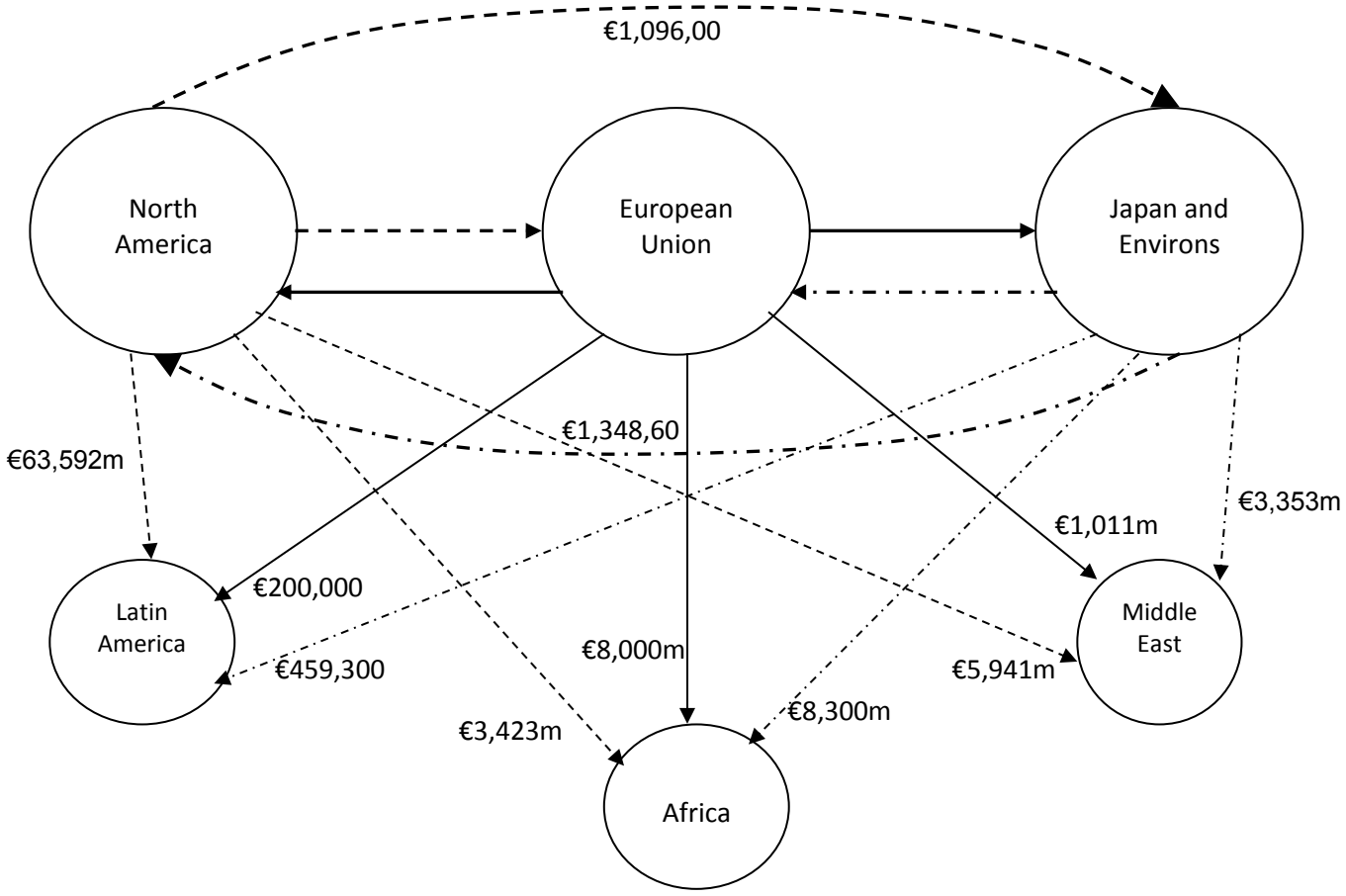
In addition, as illustrated in figure 3, FDI is dominated by intra-triadic flows. Indeed, Africa received only 0.44 per cent of total FDI in 2011, whereas the figure for the EU was 42.26 per cent, with North America receiving 22.7 per cent, Japan and its environs 17.06 per cent, Latin America, 17.72 per cent and the Middle East 0.25 per cent.

Notable also is the lack of investment in sub-Saharan Africa, totalling less than €20billion, in comparison to other underdeveloped regions (2.39 per cent of that received by Latin America). It is argued therefore that sub-Saharan Africa could engage in a strategy of increasing investable resources by increasing the level of FDI. However, the need to attract FDI on an ever increasing scale means that individual countries find themselves in competition for, necessarily finite, funds. The MNCs are attracted to invest in those economies that offer the highest level of human capital for the cheapest price (wage). Hence, FDI itself engenders dependence and the need to implement macroeconomic policies that the MNCs find the most beneficial to their own needs.

One possible response of the introduction of an asymmetric trading regime could be that the rates of return on FDI are significantly increased and therefore, the region may benefit from increased capital flows, closing the investment gap and reducing the dependency on aid. Even so, one could argue that although FDI flows are more stable than aid flows, they remain dependent on the requirements of the MNCs. It is envisaged here that asymmetric trade regimes may increase the attractiveness of economies for FDI, but enables economies to engage in independent macroeconomic policy.

Hence, what is required is the ability to create a macroeconomic environment that is conducive to economic development and therefore to an enhanced standard of living on a sustainable basis. The contention here is that this cannot be constructed from a microeconomic perspective and therefore what is required is an international trading regime that is conducive to development to be in place before determining the policies that are best suited to an individual economy. Different policies will be based on different histories, differing stages of development, skills, populations and capabilities. Hence, whether an economy follows an export oriented strategy or import substitution, or even a developmental state model must depend on individual economic and political circumstances. The point is that a stable and predictable trading regime that breaks the ties of dependence is an essential prerequisite for any developmental strategy to succeed.

Figure 3 Triadic relationship of Foreign Direct Investment (2011)



Sources: Ministry of Finance (Japan); US Census Bureau; Eurostat

Thus, an asymmetric trading regime advocates that free trade is not only promoted by the triadic nations, but is also practiced, in the sense that their economies be tariff and quota free to the goods produced in sub-Saharan Africa. In turn, the sub-Sahara African countries would be at will to impose whatever restrictions are deemed necessary to create an economic environment within which sustainable economic development can flourish; replicating the conditions under which the now advanced economies themselves developed. The level of tariffs and quotas will obviously differ depending upon the circumstances of each individual economy.

7. Conclusions

The argument is that the existing international trading regime cannot be justified on historical, moral or economic grounds and that asymmetric trading is a credible alternative. The arguments, in opposition to the Washington consensus, are strong when presented separately, and even more powerful and persuasive when integrated. From historical, moral and economic perspectives, the removal of dependency through asymmetric trading regimes could provide the macroeconomic environment required for independent and self-sustaining development in sub-Saharan Africa. Such a shift in policy on the part of the triadic nations would not present practical difficulties, but would have to overcome political opposition.

This requires hegemonic power to reject the orthodox comparative advantage model of free trade and an acceptance of an alternative model geared to the development of the contemporary underdeveloped economies. However, the arguments presented here not only affirm the moral and economic imperative, they also suggest that historically the waves of capitalism, and therefore the phases of economic development, have been driven by such an alternative model.

Hence, what is required is the ability to create a macroeconomic environment that is conducive to economic development and therefore to an enhanced standard of living on a sustainable basis. The contention here is that this cannot be constructed from a microeconomic perspective and therefore what is required is an international trading regime that is conducive to development to be in place before determining the policies that are best suited to an individual economy. Different policies will be based on different histories, differing stages of development, skills, populations and capabilities. Hence, whether an economy follows an export oriented strategy or import substitution, or even a developmental state model must depend on individual economic and political circumstances. The point is that a stable and predictable trading regime that breaks the ties of dependence is an essential prerequisite for any developmental strategy to succeed.

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One could not be so naïve as to expect altruism on the part of the triadic nations to the extent that they accept the model of asymmetric trade just to assist the underdeveloped economies out of poverty. Therefore, what is now required is a comprehensive review of the advantages that exist, not only for sub-Saharan Africa but also for the triadic states themselves in terms of, increased future demand for their goods and services as per capita income rises in the region as a whole, the social and political stability that this could engender in the region and for the MNCs seeking greater guarantees for their investments that production behind tariff barriers and quotas can achieve, certainly in the short-run.

Again, historical precedence suggests that this could be the outcome – a mutually beneficial trading regime. The experience after World War One of world depression and the rise of fascism, led the participants of the Bretton Woods Conference to instigate a new order that emphasised the need to reconstruct the devastated European and Far East economies to the mutual advantage of all Western nations. This entailed abandoning the strategy of free trade.

The argument here is essentially that such a strategy should be reinstated for the devastated economies of the 21st century, employing a sophisticated model of international trade to the benefit of all nations.

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Rationality in the Theory of the Firm

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Abstract

We have previously presented a critique of the standard Marshallian theory of the firm, and developed an alternative formulation that better agreed with the results of simulation. An incorrect mathematical fact was used in our previous presentation. This paper deals with correcting the derivation of the Keen equilibrium, and generalising the result to the asymmetric case. As well, we discuss the notion of rationality employed, and how this plays out in a two player version of the game.

1. Introduction

Keen [3, Ch 4] pointed out a fundamental flaw with the standard Marshallian theory of the firm, whereby the market demand function $P(Q)$ (price of a good given total market production Q) is assumed to be a decreasing function of Q (i.e. $P'(Q) < 0$), yet at the same time, for a large number of firms, each individual firm's production qi has no effect on market price, i.e. $\partial P/\partial q_i = 0$. Yet it is easy to see from elementary calculus, that these two conditions cannot be true simultaneously, as first noted by Stigler [7].

Marshallian analysis proceeds under this assumption that individual firms' actions have no effect on the market, leading to the profit maximum for each firm to occur when its marginal cost is equal to the market price.

In [5, 4], we argue that the economy's equilibrium will not occur at the zero of the partial derivative of the individual profit function, but rather when the total derivative of each individual profit with respect to market production is simultaneously satisfied. This leads to a revised prediction of the difference between market price and marginal cost being related to the slope of the demand curve:

$$P(Q) - MC(q_i) = -nq_i\,P'(Q) \tag{1}$$

Furthermore, a simple reactive rational agent model of the firm produced results compatible with the Keen equilibrium, and not the Cournot-Nash equilibrium predicted from standard Marshallian analysis. It should be pointed out that this agent model makes neither the partial derivative assumption of Marshallian analysis, nor the total derivative assumption of Keen's analysis, but rather the agents seek to always optimise their profits assuming the past is a guide to the future.

Anglin [2] critiqued our 2006 paper, but the critique was not without its own mathematical difficulties. We extensively rebutted his paper in a submission to the same journal in which our 2006 paper, and Anglin's critique appeared. This was rejected on editorial privilege. We chose not to publish the rebuttal in another journal, as the rebuttal doesn't advance the state of the field, but have made it available via arXiv [6], for those who might be interested.

Nevertheless, in the course of corresponding with Anglin, the main issue bothering Anglin was identified as an erroneous mathematical assumption we made for the value of dq_i/dQ, for which no such assumption can be made. This paper serves to correct the analysis, and also correctly generalise the Keen analysis to the asymmetric firm case. As a consequence, our previous attempt described in section 3 of [4], which Anglin ridiculed as "conjectural variation", is no longer relevant.

The purpose of this paper is not to rebut Anglin's paper, but to correct a problematic assertion in our work, and consequently extend the Keen analysis to asymmetric firm response.

2. The profit formula

We take as our starting point, the usual profit formula of a single product market with n firms:

$$\pi_i = q_i\, P(Q) - \int_0^{q_i} MC\ (q_i) dq_i, \tag{2}$$

where π_i is the profit obtained by firm i, as a function of its production q_i, and the total market production $Q = \sum_i q_i$. The function $P(Q)$ is the demand curve, namely the price the good achieves when Q items of the good is available on the market. In the following, $P(Q)$ is taken to be a monotonically decreasing curve ($P' < 0$). The function $MC\ (q_i)$ is the marginal cost of producing an extra item of the good, given that a firm is producing q_i items.

3. Rationality

The key concept of the rational agent, or homo economicus is that the agent chooses from an array of actions so as to maximise some utility function. In the context of the theory of the firm, the utility functions are given by π_i in eq (2), and the choices are the production values chosen by the individual firms.

Intrinsic to the notion of rationality is the property of determinism. Given a single best course of action that maximises utility, the agent must choose that action. Only where two equally good courses of action occur, might the agents behave stochastically. This deterministic behaviour of the agents is the key to understanding the stability of the Keen equilibrium, and the instability of the Cournot equilibrium, which is the outcome of traditional Marshallian analysis.

When setting up a game, it is important to circumscribe what information the agents have access to. Clearly, if the agents know what the total market production Q will be in the next cycle, as well as their marginal cost MC, the rational value of q_i can be found by setting the partial derivative of π_i to zero:

$$\frac{\partial \pi_i}{\partial q_i} = P + q_i\, \frac{\partial P}{\partial q_i} - MC(q_i) = 0 \tag{3}$$

Indeed, the Marshallian theory further assumes that in the limit as the number of firms n tends to infinity, the term $\partial P/\ \partial q_i \to 0$, to arrive at the ultimate result that price will tend to the marginal cost (assuming a unique marginal cost exists over all firms)[1, p. 322]. This assumption is strictly false, as shown by [7]. Instead, $\partial P/\ \partial q_i = dP/dQ$, which is independent of the number firms in the economy. The Cournot-Nash model starts with each agent knowing that all other agents are rational, and their marginal cost curves, consequently (under the right circumstances) being able to predict the optimal production levels for each agent. Therefore, the total production Q is predictable, and equation (3) should hold. Furthermore, for certain distributions of market share (eg the symmetric case of equal market share where $q_i = Q/n$), individual production levels vanish in the limit $n \to \infty$. Therefore $P \to MC$. This result is known as the Cournot theorem.

However, it is completely unrealistic for the firms to be able to predict market production (and hence price). Firms cannot know whether their competitors will act completely rationally, and details such as the marginal cost curve for each firm, and even the total number of players is unlikely to be known. So equation (3) cannot be correct. Instead, firms can really only assume that the price tomorrow will most likely be similar today, and that the best they can do is incrementally adjust their output to “grope for” the optimal production value. So in our model, firms have a choice between increasing production or decreasing it. If the previous round’s production change caused a rise in profits, the rational thing to do is to repeat the action. If, on the other hand, it leads to a decrease in profit, the opposite action should be taken. At equilibrium, one would expect the production to be continuously increased and decreased in a cycle with no net movement.

4. Game theoretic analysis of the Cournot equilibrium

For simplicity, assume a two firm system with identical constant marginal costs, that has been initialised at its Cournot equilibrium ($P + QP'/2 - MC = 0,\ q_1 = q_2 = Q/2$). There are three possible outcomes for the next step:

1. Both firms increase production. This reduces the price fetched for each firm. The right hand side of equation 3 becomes negative, reducing the profits of both firms. The logical next step is for both firms to decrease production, which is covered under item 3.

2. One firm increases production whilst the other decreases it. If the production increment is the same in each case, then the market price does not change. The net effect is of one firm gaining market share at the expense of the other. In this case, the firm losing market share will switch to increasing production, whilst the other firm will continue increasing production. This is situation described by item 1.
   If the production increments differed between firms, then there are two cases: if the firm with larger increment increases, and the increment is sufficiently big, then profit levels will fall for both firms. The dynamics returns to the original (Cournot) point. Otherwise, the firm losing market share will switch to increasing, which is situation 1.

3. Both firms decrease production. In this case, provided the price is higher than the monopoly price, both firms' profits will rise, leading to another round of production decreases.

The net result is that the Cournot equilibrium is unstable in the direction of both firms decreasing production. The n-firm case can be analysed in the same way [5]. The situation where the majority of firms are decreasing their production simultaneously will occur by chance within a few cycles of the system initialisation. From there, the entrainment of all firms into the production-reducing behaviour happens rapidly, until the system stabilises at monopoly prices.

It is important to note, that this effect depends on the deterministic nature of the agent behaviour, a result of the assumption of rationality. Presumably, most real economic agents are not as rational as this, and the introduction of 30% irrationality into the agents is sufficient to ensure competitive pricing [5].

5. Derivation of the Keen equilibrium

Mathematically, global equilibrium will occur when all partial derivatives $\partial \pi_i / \partial q_j$ vanish. However, this situation can never pertain, as $\forall i \neq j$, $\partial \pi_i / \partial q_j = q_i P' < 0$ except possibly for the trivial solution $Q = 0$.

Instead we propose the condition that all firm's profits are maximised with respect to total industry output $d\pi_i / dQ = 0$. This constrains the dynamics of firms' outputs to an $n - 1$-dimensional polyhedron, but otherwise does not specify what the individual firms should do. As an equilibrium condition, it is vulnerable to a single firm "stealing" market share. However, no firm acts in isolation. The other firms will react, negating the benefit obtained by first firm, causing the system to settle back to the $d\pi_i / dQ = 0$ manifold.

The derivation of the Keen equilibrium follows the presentation in [4]. The total derivative of an individual firm's profit is given by

$$\frac{d\pi_i}{dQ} = P\,\frac{dq_i}{dQ} + q_i \frac{dP}{dQ} - MC(q_i)\frac{dq_i}{dQ} \tag{4}$$

which is zero at the Keen equilibrium.

In terms of the model introduced in §4, there is no absolute equilibrium, but rather a limit cycle where the individual firms are "jiggling" their outputs around the equilibrium value. If we average over this limit cycle, and retaining only zeroth order terms in Δq_i, we get

$$\left\langle \frac{d\pi_i}{dQ} \right\rangle = P(\langle Q \rangle) \left\langle \frac{dq_i}{dQ} \right\rangle + \langle q_i \rangle P'(\langle Q \rangle) - MC(\langle q_i \rangle) \left\langle \frac{dq_i}{dQ} \right\rangle$$

$$= P\theta_i + q_i P' - MC(q_i)\theta_i = 0. \quad (5)$$

Where $\theta_i = \langle dq_i/dQ \rangle$ and the terms P, P' and q_i refer to the equilibrium average values of these quantities. The θ_i terms are normalised: $\sum_i \theta_i = dQ/\, dQ = 1$.
They can be considered to be the (normalised) responsiveness of the firms to changing market conditions.

The symmetric firm case corresponds to setting $\theta_i = 1/n$, which leads to the equation:

$$P + nq_i P' - MC(q_i) = 0 \quad (6)$$

which is equation (6) of [4].

In our previous expositions [4, 5], we incorrectly set $dq_i/dQ = \sum_j \partial q_i/\, \partial q_i = 1$ which as pointed out in a critique by Paul Anglin [2], when coupled with $q_i(Q = 0) = 0$ leads to the unjustifiable conclusion that $q_i = Q/n$ at all times. Now, in equation (5), the values θ_i only refer to the derivatives at equilibrium, so there is no necessity for (6) to entail an equi-partition of the market share.

6. Testing the Keen equilibrium

We can use an agent-based computational model based on the model introduced in §4 to test the Keen equilibrium, or more specifically, equation (5). The terms $P(Q)$, q_i and MC_i are all available as part of the model. In addition, each agent has an attribute δ_i, which is the amount that agent i varies its production up or down each time step.

We can compute the quantity θ_i by averaging $\Delta q_i/\, \Delta Q$ over $\theta_w = 10$ time steps.

In the following experiment with 1000 firms, we used a linear pricing function $P = 11 - Q/3$, and constant marginal costs MC_i drawn uniformly from the range [0.5, 0.5). The δ_i increments were drawn from a half normal distribution — i.e. the absolute values of normally distributed deviates with zero mean and standard deviation $0.002/n$. The code implementing the model, and the experimental parameter script is available as firmmodel.1.D7, from the EcoLab website (http://ecolab.sf.net).

Figure 1 shows the histogram of values taken by the statistic $q_i P' + \theta_i(P - MC_i)$ for the 1000 firms over 1378 replications. The vast majority of observed values are consistent with zero, the predicted value of eq (5), however there is a significant minority of outliers, which are not explained within the theory presented in §5.

We can, however, consider the statistic $\xi = q_i P'/(MC_i - P)$, which in the Cournot theory should be one by (3). Figure 2 shows a histogram of ξ for a single run of the 1000 firm model. The values approximately fit a lognormal distribution, from which we can see that value $\xi = 1$ lies some 35 “sigmas” to the right of the mean, i.e. the Cournot prediction (3) is excluded to the tune of $p \approx 10^{-267}$.

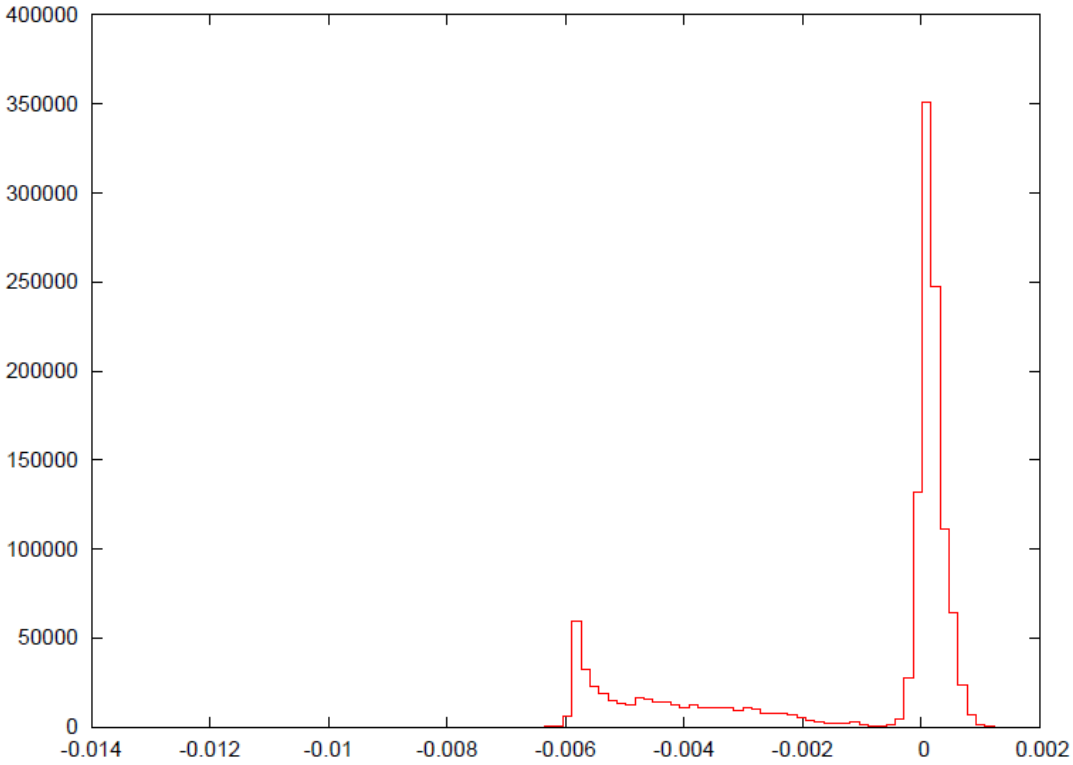

Figure 1: Histogram of the statistic $q_i P' + \theta_i(P - MC_i)$ for 1378 replications of the 1000 firm model. Most of the values are clustered close to zero, but a sizable minority have non-zero negative values. The left hand half of the histogram also has non-zero bins, but are not visible with the shown vertical scale.

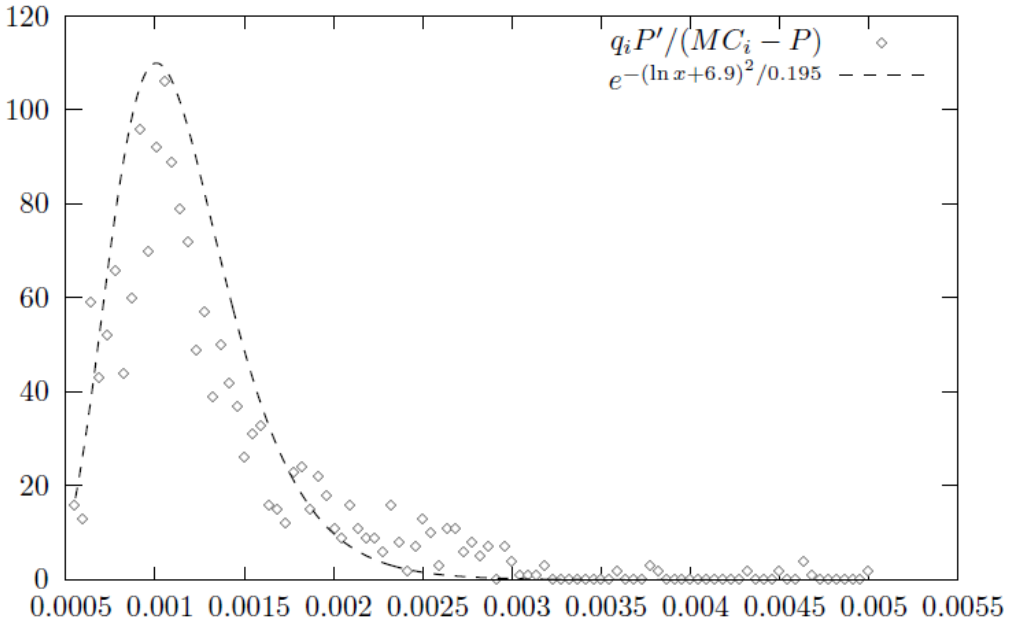

Figure 2: Histogram of the statistic $q_i P'/(MC_i - P)$ for a single run of the 1000 firm model. The dashed line shows a fitted log-normal distribution.

7. Conclusion

In this paper, we have discussed the behaviour of an n-player game of rational, but not clairvoyant, agents. This exhibits a phase of coordinated behaviour of the agents that brings market prices to near monopoly levels due to the very rationality of the agents rather than any overt coordination mechanism. We use numerical simulations to reject the traditional Cournot-Nash solution of the game.

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Toward an Understanding of Keen and Standish's Theory of the Firm: A Comment

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Abstract

In a series of papers, Steve Keen and Russell Standish criticize the textbook approaches to firm behavior under conditions of perfect and imperfect competition. These papers misstate the assumptions underlying the models and err in mathematics. The critiques do not follow through on their theoretical arguments, and do not explain what drives the results of their computer simulations. Consequently, their contributions confuse rather than clarify understanding of firm behavior.

1. Introduction: Approaching the work of Keen and Standish

Our launching point for this primer will be the article "Rationality in the Theory of the Firm" [see reference 8] – a paper appearing in this issue of *World Economic Review* which was placed into Open Peer Discussion for comment in January, 2014. However, that paper builds directly upon other papers its authors have written previously on subject of supply theory and will necessarily rely to some extent on those previous works. This review, then, summarizes and critiques that research.

Keen and Standish's papers on the subject of supply [see references 3, 4, 6, 8] pursue three distinct lines of thought. First, they argue that the textbook model of perfect competition[1] is "strictly false" [see ref. 3] in assuming the demand function has "dual [contradictory] properties" [see ref. 4] and thus the model contains a "fundamental flaw" [see ref. 8]. The second thread questions the standard Cournot-Nash oligopoly result as deficient in concluding that firms fail to find the collusive level of output. Third, simulating out an infinitely-repeated Cournot-Nash game, they argue that competitive firms all pursuing the authors' suggested strategy will find the collusive level of industry supply.

Each of these threads contain serious flaws, and this paper will address each thread in turn. However, it should be noted that each thread is in fact distinct. Each thread addresses a different model of competition (perfect, Cournot-Nash, and infinitely-repeated Cournot-Nash) and there is no particular reason to believe that the results of one thread supports another.

2. A conflicting definition

It is not entirely surprising that the critiques of Keen and Standish often seem to conflate these different models of competition. Rather, it appears to stem from non-standard definitions. According to Standish, perfect competitors "are defined as agents with no market power, which I took as being a constraint that firms must produce at marginal cost."[2] Of course, perfectly competitive firms are not constrained to produce at marginal cost; they merely have incentive to produce at that level because they have no power to change the price they will receive for their goods.

Standish continues:

[1] Nebulously and variously described in the papers as "the standard economic theory of competitive markets", "Marshallian" theory or model or analysis, and "Marshallian derivation of the model of 'perfect competition.'" In private correspondence, Keen confirmed that "modern textbook model of perfect competition" was a safe interpretation on the part of any reader when reading "the theory of atomisitic competition" or "Marshall's pure case" or "the standard Marshallian theory of the firm" or "standard Marshallian analysis."
[2] See comment submitted 19 March 2014 at 1:07 AM.

> "We are modelling 'price takers', however, that is the agent has choice over level of production, and the market delivers the clearing price. Price takers are not constrained to having 'no market power' – indeed they will always have some power, albeit diluted by the number of firms in the market place."

This is not what economists generally mean when they say a perfectly competitive firm is a price-taker. Economists generally mean that individual price-takers have no influence over the current price. Consequently, the firms described by Keen and Standish have the same market power as Cournot oligopolists; we should expect a competition among such firms to resemble not a perfectly competitive industry but a Cournot oligopoly.

Their unusual definition helps explain some of the extraordinary claims laid out in Standish and Keen's critique.

3. A relatively generic framework for a theory of firm production

Suppose, as above, that firms face an industry inverse demand curve given by $P(Q^d)$and firm i has total costs $\mathrm{TC}_i(q_i)$. Suppose that for any given period of production, firms accept some common unit price p for their current production which they may or may not know at the time they choose their individual levels of output. Then total revenues of firm i are

$$\mathrm{TR} = pq_i$$

and therefore in the given period firm i receives profits

$$\pi_i = pq_i - \mathrm{TC}_i(q_i) \qquad (3.1)$$

Note that we have not yet specified how p is determined. Nor have we made any assumption regarding how the firm selects its level of production. This framework will support all of the discussion which follows.

4. Thread 1: On the logical consistency of textbook perfect competition

The opening paragraph of Standish's most recent work [8] summarizes the authors' position (references adjusted to this document):

> "Keen [2, Ch. 4] pointed out a fundamental aw with the standard Marshallian theory of the firm, whereby the market demand function $P(Q)$ (price of a good given total market production Q) is assumed to be a decreasing function of Q (i.e. $P'(Q) < 0$), yet at the same time, for a large number of firms, each individual firm's production qi has no effect on market price, i.e. $\partial P/\partial q_i = 0$. Yet it is easy to see from elementary calculus, that these two conditions cannot be true simultaneously, as first noted by Stigler [9, footnote 31]."

There are at least three errors here. First, the market (inverse) demand function is not one of "total market production" – that is, quantity supplied. Second, $\partial P/\partial q_i = 0$ (though true) is an incorrect rendering of the price-taking assumption. Third, Stigler's argument does not directly address perfect competition; rather, Stigler is exploring Cournot's argument that imperfect competition appears increasingly perfect as the number of firms grow large.

4.1 Inverse demand is removed from the decision facing perfectly competitive firms

The first error is obvious, but points to further problems with the critique. Inverse demand is a function not of quantity supplied, but quantity demanded. Of course, it is legitimate to evaluate inverse demand at quantity

supplied, but interpretation of the result requires care. In textbook models of perfect competition, price determines quantity demanded, so if inverse demand is described by $P(Q^d)$, then $P(Q^s)$ is seen in Figure 1.

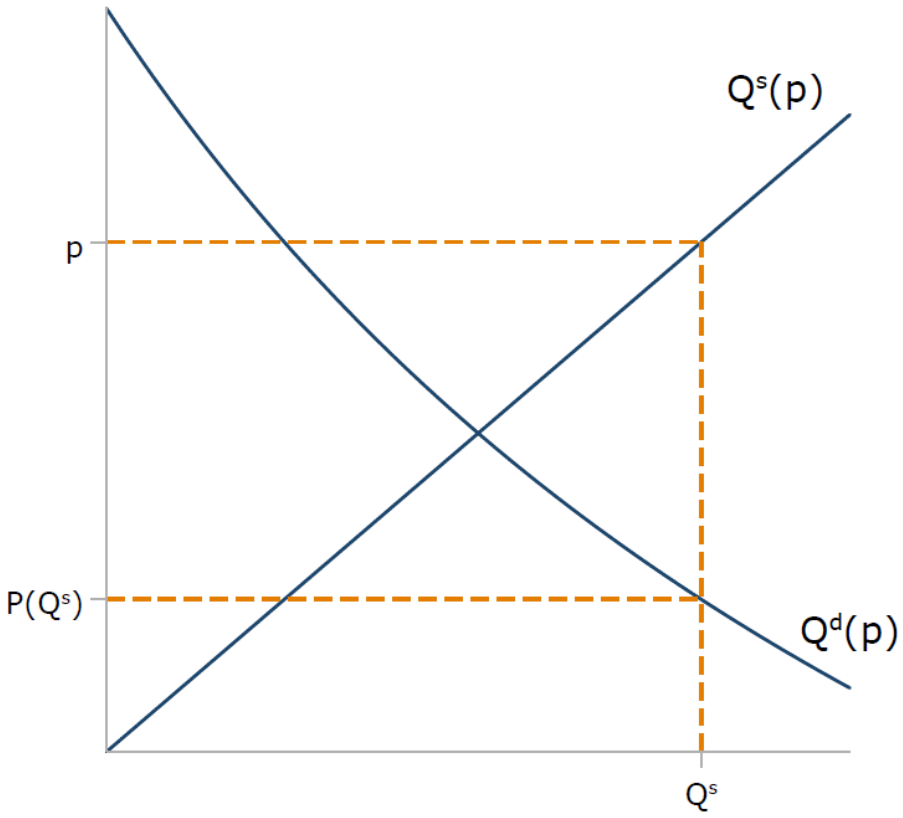

Figure 1: Determination of $P(Q^s)$

Note, as in Figure 1, that $P(Q^s)$ is not in general equal to the market price p except when p happens to be such that the market clears. While $P(Q^s)$ may indeed fall as Q^s rises, this is not the same thing as assuming P to be a decreasing function of Q^s. Rather, $P(Q^s)$ is the price which would have resulted in a quantity Q^s demanded regardless of the actual quantity supplied.

The critique fails to recognize that perfect competition (as opposed to Cournot oligopoly) allows for a market price p such that $Q^d \neq Q^s$ and hence the possibility of a failure to clear the market. Indeed, Standish argues that the two must be identical.[3] Yet the possibility of a non-clearing market price p is critical to textbook analyses of binding minimum wage and rent-control laws; the assumption that market prices always clear the market is not fundamental to perfect competition.

Even if p is assumed to clear the market, the relationship between Q^s and p is not so clear. A positive demand shock increases both quantity supplied and the market-clearing price.

Indeed, in [4] above Figure 9 the authors declare "If the market demand curve slopes downwards, then the *a priori* rational belief is that *any* increase in output by the firm will depress market price" (emphasis in original.) This is plainly false. According to the textbook model of perfect competition, by the time firms begin to make their production decisions the market price is already fixed and so may not fall. Rather, an increase in output results in additional excess supply. It's absolutely rational for the price-taking firm to believe that it will not depress its supply price by increasing output because it operates in a universe where the period's price is already set.

By contrast, this same logic need not apply to models of *imperfect* competition. In Cournot oligopoly, for example, firms do have market power and the market is *assumed* to clear *ex-post* in the

[3] See comment submitted 18 March 2014 at 2:34 AM.

manner described by Standish and Keen. Cournot firms make their output decisions prior to receiving a supply price, and only after the decisions are revealed is the market-clearing supply price $p^C = P(Q^s)$ known to the firm. By insisting that firms have the power to move market prices by varying their individual outputs, we see that the "price takers" of Standish are actually Cournot oligopolists – imperfect competitors, not perfect.

4.2 $\partial P/\partial q_i$ has no obvious connection to price-taking

As to the second error, again note that P is defined as inverse demand - a function of quantity demanded, and not of any firm's quantity supplied. By definition then, $\partial P/\partial q_i = 0$. It is not clear why this conflicts with $P' < 0$.

If, however, when Standish and Keen write "each individual firm's production q_i has no effect on market price" they mean not the market-clearing price but the supply price then this ought to be written either $\partial p/\partial q_i = 0$. Textbook price-taking requires this to be true: each period's p is determined prior to any firm's actual decision. It is not possible for the firm decision to influence directly or indirectly market price p even though p may be determined endogenously via the supply schedule.

Still, Standish's non-standard definition of "price-taking" helps clarify what the authors intent. Let us start by defining a function Q^{s*} so that quantity supplied is given by $Q^s = Q^{s*}(q_1, q_2, \ldots, q_n) \equiv \sum_j q_j$ and that $p^*(q_1, q_2, \ldots, q_n) \equiv P\left(\sum_j q_j\right) = P(Q^s)$. Now, $\partial p^*/\partial q_i = P'(Q^s) < 0$ so long as demand is downward-sloping. This is just as we discussed above – firm choices may alter the *ex-post* market-clearing price.

Likewise, under the non-standard definition, an individual consumer may alter the ex-post market-clearing price. Suppose a consumer may walk into a store where apples are advertised at $1.27 per pound, happy to purchase two pounds at that price. According to the logic laid out in the critique, the consumer may be able to purchase only one pound for only $1.26. This contrasts with the observed practice of discounting bulk purchases. In any case, this describes imperfect and not perfect competition.

It is also worth noting that nothing here depends on "a large number of firms" as the authors suggest. These relations are just as true for a perfectly competitive monopoly. Of course, perfect competition might be a poor choice of model with which to analyze the monopoly. But the results are no less consistent.[4]

4.3 Stigler is correct, but does not undermine price-taking

Finally, we come to Stigler. In his article [9, p. 8], Stigler argues (emphasis added, footnote marker in original):

> It is intuitively plausible that with infinite numbers all monopoly power (and indeterminacy) will vanish, and Edgeworth essentially postulates rather than proves this. But a simple demonstration, in the case of sellers of equal size, would amount only to showing that
>
> $$\text{Marginal revenue} = \text{Price} + \frac{\text{Price}}{\text{Number of sellers} \times \text{Market elasticity}}$$
>
> and that this last term goes to zero as the number of sellers increases indefinitely.[31]
> This was implicitly *Cournot's* argument.

Stigler's "demonstration" reflects the Cournot Theorem – that as the number of imperfect competitors in a Cournot oligopoly becomes increasingly large, the industry behavior increasingly approaches that of perfect competition. Marginal revenues approach market price, and firm production is such that marginal costs approach market price.

[4] A monopoly need not have any pricing power even if textbook models of monopoly generally assume they do. Perhaps the government fixes the price on behalf of the firm, yet allowing it to produce any volume of output it chooses. The government may even agree in advance to purchase any and all of the firm's supply while banning all other sales. In other words, a market may be structured so that the firm faces a perfectly flat demand curve and $P'(Q^d) = 0$. Price-taking is not incompatible with monopoly.

If it is true that as the number of competitors increase firms market power tends to zero, then it is reasonable to imagine a competition in which firms have zero market power. We may then as well ask directly how firms behave in the absence of such market power. We may find such perfect competition does a poor job of representing a real-world market, but we are free to make the assumption.

The important point is that Stigler is working with a model of imperfect competition; his precise construction depends upon assumptions in the Cournot oligopoly model. By contrast, market price is determined prior to the decision of any price-taking firm (under the generally-accepted definition) so the perfectly competitive marginal revenue must be exactly equal to market price.

5. Thread 2: On the correctness of the Cournot-Nash result

Suppose firms compete in the fashion of a Cournot oligopoly. That is, they individually produce whatever they choose, then the supply price adjusts to clear the market. The authors state [8]:

> Mathematically, global equilibrium will occur when all partial derivatives $\partial\pi_i/\partial q_j$ vanish. However, this situation can never pertain, as $\forall_i \neq j$, $\partial\pi_i/\partial q_j = q_i P' < 0$, except possibly for the trivial solution $Q = 0$.

The critique here confuses equilibrium and extremum. Competitive profit maximization does not mean that firms are in equilibrium if they arrive at a global profit maximum. Reaching global profit maximum for all firms is impossible even with collusion as each firm's maximum is achieved when all competition vanishes and it monopolizes the market. Such conditions are mutually incompatible across firms. Rather, competitive equilibrium requires only that each firm is satisfied with its own production decision given the production levels of its competitors. So satisfied, no firm has incentive to change, and the production levels are therefore stable. The authors continue (emphasis added, reference adjusted):

> The key concept of the *rational agent*, or *homo economicus* is that the agent chooses from an array of actions so as to maximise some utility function. In the context of the theory of the firm, the utility functions are given by π_i in eq (5.1), and the choices are the production values chosen by the individual firms.
>
> Intrinsic to the notion of rationality is the property of determinism. Given a single best course of action that maximises utility, the agent must choose that action. Only where two equally good courses of action occur, might the agents behave stochastically. This deterministic behaviour of the agents is the key to understanding the stability of the Keen equilibrium, and the instability of the Cournot equilibrium, *which is the outcome of traditional Marshallian analysis*.

It is perhaps better to write that utility functions describe the choices agents make and that if agents aim to maximize profits, then the modeler's choice of profit function as utility will most accurately describe the choices agents make. This aside, the last sentence underlines the problem of the previous chapter. No known model of perfect competition has ever brought forth the Cournot equilibrium. It may be argued that the traditional analysis of the Cournot oligopoly has limiting behavior which reflects the outcomes of perfect competition, but there is no analysis which starts with perfect competition and arrives at the Cournot equilibrium.

Again, this suggests that Standish's non-standard definition of price-taking had led the authors to confuse textbook models of perfect and imperfect competition.[5] Putting that aside, we clarify. Given *the*

[5] Seen also in the blurring of models in [6] around equation 16, where the authors describe a "Cournot" result by taking the limit as the number of firms goes to infinity. While the industry production they write is indeed the limit of production in a Cournot oligopoly, it is *not* clearly the level of output produced by any number of firms in perfect competition. If the supply price is indeed $p = c$, then

expected actions of its competitors and a single best course of action for the i*th firm* that maximizes π_i, the ith firm must choose that action. One takeaway from the Cournot analysis is that there is a consistent set of outputs which so satisfy all the firms.

Consider the Cournot duopoly. Firm 1 is satisfied with its choice of operating at the Cournot level if its competitor has also chosen to operate at its own Cournot level. Not only that, but so long as firm 1 operates at its Cournot level, it has structured the incentives of its competitor so that firm 2 will naturally choose to operate at its own Cournot level. Firm 1's belief in firm 2's choice becomes a prophecy fulfilled. The fact that $\partial\pi_1/\partial q_2 < 0$ becomes irrelevant to firm 1 at Cournot-Nash because firm 1 believes (sensibly) that from the Cournot level of output, $dq_2 = 0$.

Standish and Keen reject this and "propose the condition that all firm's profits are maximized with respect to total industry output $d\pi_i/dQ = 0$." Now, let us write more carefully,

$$\pi_i(q_i,\ Q^s) = P(Q^s)q_i - TC(q_i) \tag{5.1}$$

So that

$$\frac{d\pi_i(q_i, Q^s)}{dQ^s} = \frac{dP(Q^s)}{dQ^d}\frac{dQ^d}{dQ^s} + P(Q^s)\frac{dq_i}{dQ^s} - \frac{d\mathrm{TC}(q_i)}{dq_i}\frac{dq_i}{dQ^s}$$

Assuming that post production the price will adjust to always clear the market $(Q^d = Q^s)$ and noting that

$$\frac{dQ^s}{dq_i} = \sum_j \frac{\partial Q^s}{\partial q_j}\frac{dq_j}{dq_i} = \sum_j \frac{dq_j}{dq_i}$$

And the authors' condition reads

$$\left(\sum_j \frac{dq_j}{dq_i}\right)\frac{dP(Q^s)}{dQ^d}q_i + P(Q^s) - \mathrm{MC}(q_i) = 0 \tag{5.2}$$

This appears to confuse firm behavior with comparative statics. As a description of firm behavior, it is simply a restatement of the Cournot equilibrium. Because all firms reveal their outputs simultaneously, the rest of industry cannot tailor its output in response to the whim of any single firm. Thus, each firm must necessarily believe that $dQ^s/dq_i = 1$, leading to the standard Cournot result.

This is not the same as saying that the firm must believe dQ^s/dq_i must be 1 in a dynamic setting. As a matter of comparative statics, for example, we might ask how the equilibrium changes in response to a demand shock. For example, if we assume linear (inverse) demand $P(Q^d) = \alpha - \beta Q^d$ and N firms with zero production costs. Then the Cournot-Nash level of production for each firm is $= \alpha/3\beta$. If demand is greater by $d\alpha$, then all firms produce at a level $d\alpha/3\beta$ greater. In the face of a demand shock, then, $dQ^s/dq_i = N$.

In other words, the firm may know that if it has incentive to produce at a higher level, then so do its competitors; this is different from believing that if it then produces at a lower level, then so will its competitors. Continuing, (edited for clarity, reference adjusted):

> When setting up a game, it is important to circumscribe what information the agents have access to. Clearly, if the agents know what the total market production Q^s will be in the next cycle, as well as their marginal cost MC, the rational value of q_i can be found by setting the partial derivative of π_i to zero:

firm profits are exactly zero no matter how much the firm produces. *In the limit* constant marginal costs imply indeterminate supplies. This is why perfectly competitive modeling usually require *increasing* marginal costs, rather than constant.

$$\frac{\partial \pi_i\,(q_1, q_2, \ldots., q_n)}{\partial q_i} = P + q_i\,\frac{\partial \mathrm{P}}{\partial q_i} - \mathrm{MC}(q_i\,) = 0 \qquad (5.3)$$

Indeed, the Marshallian theory further assumes that in the limit as the number of firms n tends to infinity, the term $\partial P/\,\partial q_i \to 0$, to arrive at the ultimate result that price will tend to the marginal cost (assuming a unique marginal cost exists over all firms) [5, p. 322]. This assumption is strictly false, as shown by [9]. Instead, $\partial P/\,\partial q_i = dP/dQ$, which is independent of the number firms in the economy.

Once again, this discussion leaves much unpacking do be done. Of course agents need not "know" what total production will be. The firm will maximize based on its belief respecting the choices of all other firms. Taking into account the expected production coming from the rest of industry, the firm may infer the price it will receive as a function of its own decision. The formula should read

$$\frac{\partial \pi_i\,(q_1, q_2, \ldots., q_n)}{\partial q_i} = P + q_i\,P'\left(\sum_{j=1}^{n} q_j\right) - MC(q_i\,) = 0 \qquad (5.4)$$

Neither "Marshallian theory" nor any known textbook derivation of the Cournot result "assumes" that $\partial P/\,\partial q_i$ approaches zero. Rather, it is zero by definition as seen in Section 4.2 and the reference to Mas-Colell [5, p. 322] does not appear to support the claim. Likewise, Stigler [9, p. 8] nowhere shows this "assumption" or result to be false, but rather outlines proof of the result as we saw in Section 4.3.

Finally, the expression $dP = dQ$ is *not* in general independent of the number of firms in the oligopoly unless the demand curve is linear. As the number of Cournot competitors increases, so does industry production and therefore equilibrium moves down the demand curve.

There is no dispute as to whether or not profits *would be higher* at, say, the collusive result. Objectively, profits would be higher at that level than Cournot-Nash, and firms would be better off producing at that level. The neoclassical argument is that collusion is rational, but firms *competing* for the greatest profits will not forgo opportunities to increase their individual profits and so will over-produce (relative to the collusive level) even if that would result in lower profits for the industry on the whole. That is, competition hurts profits.

This is the orthodox argument for anti-trust actions; it is in the public interest to make sure firms compete rather than collude. Standish and Keen's generalization to asymmetry cannot address this deficiency in their analysis.

While the authors' critique of Cournot-Nash is up to this point is awed, they proceed to argue that the assumptions underlying the model are unrealistic, and begin to offer their own alternative model for competition. While Standish and Keen are free to offer an alternative model of production – perhaps one they consider more realistic – this can in no way prove illogical any textbook model. Nor can it prove "the instability of the Cournot equilibrium."

6. Thread 3: An alternative model of firm behaviour

Imagine you are trying to climb a smooth hill with neither ruts nor stones to stumble over. The peak is in front of you and there is a valley behind. You take a step forward and for some reason not immediately obvious, your GPS records that your elevation fell. So you take a step back, and even more confusing, you find that your elevation fell again. You keep changing course: forward, back, forward, back and all the while, you race toward the valley despite your blindingly sensible hill-climbing technique.

Why are you failing? Did you forget to look around and note that you are actually dancing back and forth in a wagon racing downhill with no brakes? You are failing because you falsely believe you are in control of whether you go up or down the hill when reality puts you at the mercy of your environment.

Such is the case with the firms of Standish and Keen. They literally misunderstand the consequences of their own decisions, and are too "rational" to question their approach. Standish and Keen introduce their alternative oligopoly model as follows (reference adjusted):

> [I]t is completely unrealistic for the firms to be able to predict market production (and hence price). Firms cannot know whether their competitors will act completely rationally, and details such as the marginal cost curve for each firm, and even the total number of players is unlikely to be known. So equation (5.3) cannot be correct. Instead, firms can really only assume that the price tomorrow will most likely be similar today, and that the best they can do is incrementally adjust their output to "grope for" the optimal production value. So in our model, firms have a choice between increasing production or decreasing it. If the previous round's production change caused a rise in profits, the rational thing to do is to repeat the action. If, on the other hand, it leads to a decrease in profit, the opposite action should be taken. At equilibrium, one would expect the production to be continuously increased and decreased in a cycle with no net movement.

The discussion starts out just fine. Standish and Keen argue that Cournot assumptions are unrealistic in that firms may not have quite so much information as the model allows. This is a completely valid critique of Cournot oligopoly. It disputes the applicability of the Cournot model – in contrast to the first thread, where the authors dispute the internal consistency of the textbook model of perfect competition. It also stands in contrast to the second thread, where the authors dispute the result of competition under Cournot assumptions. Here, the authors ask firms to play a different game. Just as someone playing backgammon behaves differently than someone playing chess, so firms playing a Standish-Keen game may behave differently than firms in a Cournot oligopoly in turn behaving differently than firms in perfect competition.

Then the authors reasonably – given the change in information given to firms – offer up an alternative approach to firm decision-making. Where the authors start to fall down is when they call their algorithm for output adjustment "rational." The hill-climber dancing in the wagon may impress with such commitment to an erroneous idea of how the world works, but "rational" may not describe the hill-climber very well. As we will see, the behavior of firms of Standish and Keen is better described as erratic rather than reasonable.

6.1 A note on "profit maximization"

It is important to note that Standish and Keen suggest an iterative procedure for reaching equilibrium. In each iteration, firms play a Cournot game. This is significant because the authors outline a function for profit for a single period only. However, as Anglin [1] correctly points out, "proposing a longer horizon would also add other dimensions to the optimization problem that KS do not consider." Among these other dimensions, if the firms are expected to play a game over multiple periods, the objective function ought be defined differently.

If we call $\pi_{i,t}$ the profits for firm i in period t, then what exactly is the firm aiming to maximize? The authors might have chosen any of the following examples – among many others – as legitimate "profits" for firm i to maximize:

$$\pi_{i,t} \qquad \sum_{j=1}^{n} \pi_{i,j} \qquad \sum_{j=j_0}^{j_0+n-1} \pi_{i,j}$$

$$\sum_{j=1}^{n} \rho^{j-1} \pi_{i,j} \qquad \pi_{i,1000} \qquad \sum_{j=1}^{\infty} \rho^{j-1} \pi_{i,j}$$

Obviously, firm behavior depends on the choice of objective function. In particular, it is a well-established result of game theory that firms playing an infinitely-repeated Cournot-Nash game may produce a rich variety of competitive equilibria.

Of course, the variety of equilibria possible in the infinitely-repeated Cournot-Nash game does not disprove the textbook analysis of the simple Cournot oligopoly. They are different games, and so the different outcomes are not in conflict. Standish and Keen address this concern arguing in [7]:

> This can be interpreted as firms anticipating what their competitors might do, although we tend to regard it as describing reactions to competitors in a "time-free" model, so the variation is not conjectural but reactionary.

In other words, they would have each firm offering some kind of tentative level of output and reacting to the revealed plans of other firms before everyone adjusts output, and so on until the firms reach some sort of equilibrium. Indeed, this is often how Cournot production is initially presented, with the understanding that in Cournot-Nash, each firm privately simulates out this adjustment process to learn its optimal production level. However, this is totally inadequate for Standish-Keen competition as they presume firms cannot know the price they will receive except through the market. In other words, they must receive actual prices in the market, and lock in actual profits as they progress.

Implicitly, Standish-Keen firms discount to zero all profits made in any finite time, leaving $\Pi_i = \pi_{i,\infty}$. But of course, tomorrow never comes. Thus, the authors view equation (5.1) as a description of a particular condition when firms are in equilibrium - not to be confused with an equilibrium condition. However, as we will see, this belies the authors' description of their simulations. Though the firms of Standish and Keen's simulations do not perform calculus to find the solution, they do quite actively solve equation (5.2). That is, it is no mere emergent outcome, but does in fact represent the firms' "behavioral rule."

Absent a clear objective function, though, the trade-offs between current and future profits are not specified. Still, the analyses of Standish and Keen are deficient in other important ways.

6.2 A wagon, not a hill

Though they say firms "grope," the authors imagine firms as hill-climbers. Firms increase or decrease output, rather than move forward or back, and they observe whether their profits – rather than elevation – rose or fell.

In the extreme case of Cournot-Nash equilibrium, all firms have optimized profits with respect to their own output and so each firm's profits are by construction insensitive to small changes in its own output. There, firm profits rise and fall based exclusively upon the choices of its competitors. Yet Standish and Keen would have the firms act as though they believed the opposite – that their own choice of output is the sole cause of any change in their own profits.

If a firm's wagon is climbing, then a step forward will coincide with an increase in elevation. However, so will a step backward. This is seen in Figure 2 where a symmetric 1,000-firm oligopoly as in [8, Sec. 6] starts in Cournot-Nash equilibrium, but all firms decide to cut output. If one firm had chosen instead to expand output, its profits would have been the tiniest bit larger. Both outcomes are shown, along with the iso-profit lines for each case.

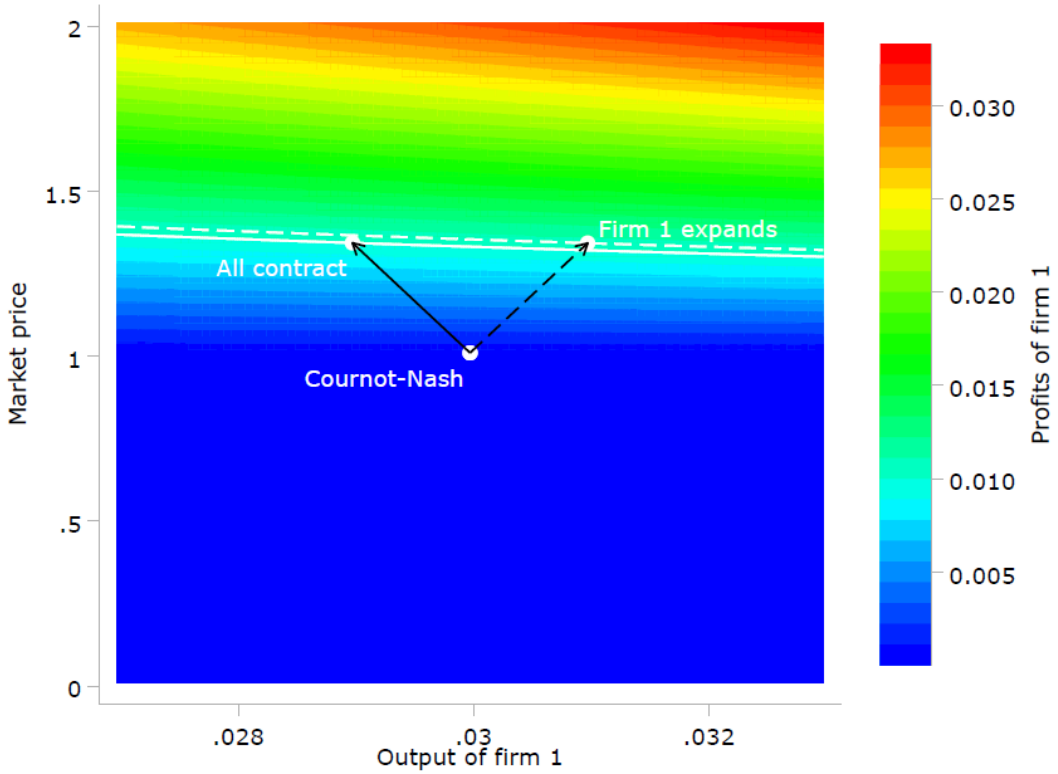

Figure 2: Oligopoly firm 1's profits rise no matter what choice it makes.

The possibilities of firm 1's expansion or contraction is entirely irrelevant to the direction its profits move. Rather, the profits of firm 1 rise because all other firms contracted (though profits rise even more if firm 1 expands.) Still, if the firm is ignorant of its alternatives in the vicinity of Cournot-Nash, the problem is far worse nearing the collusive level of production as seen in Figure 3.

Again it is true that by continuing to contract, the profits of all firms increase. However, the increase is marginal – almost nonexistent. Any firm would see a much larger increase in profits by expanding.

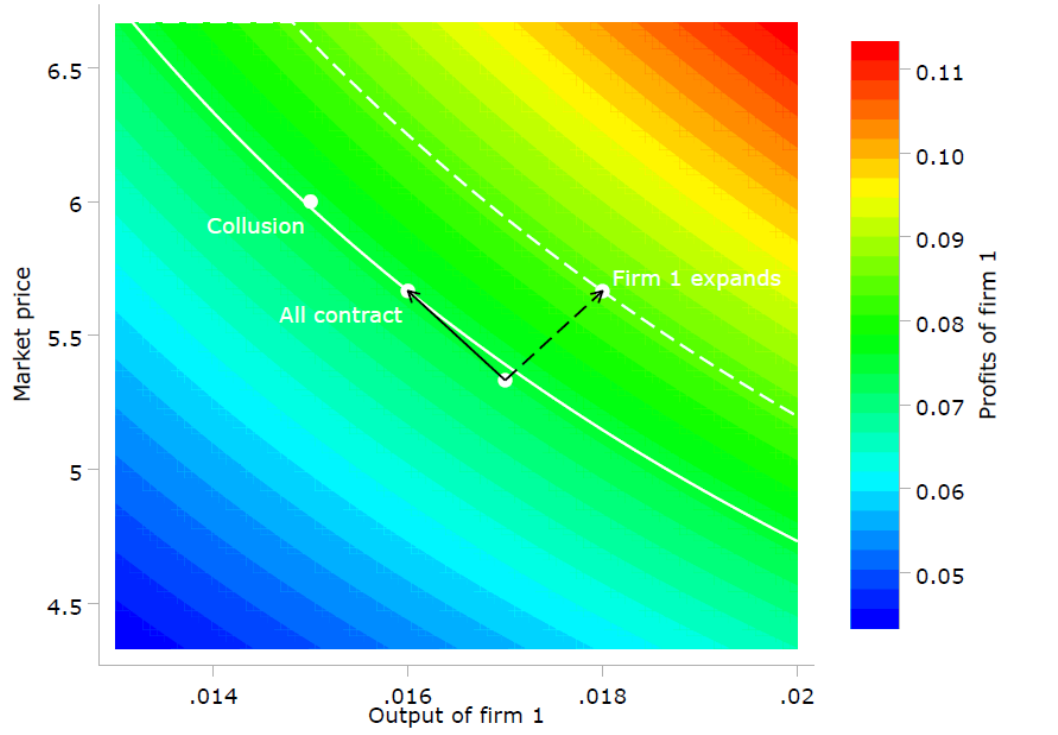

Figure 3: Oligopoly firm 1's profits rise either way, but rise much faster when expanding.

Of course, if all firms expanded, each would suffer losses, however marginal. The firms are technically in a Prisoner's Dilemma.

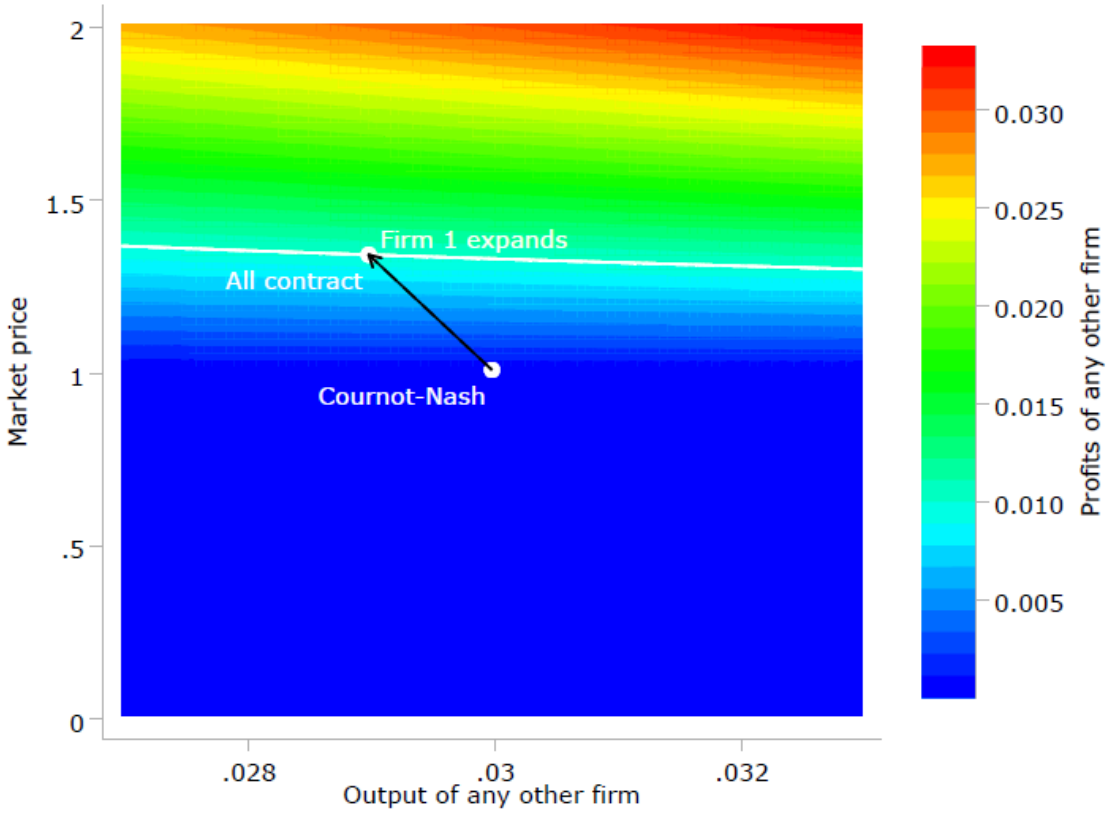

Figure 4: Other firms in a large oligopoly hardly perceive any difference of a single firm's expansion.

Note that in such a large oligopoly, expansion on the part of a single firm from Cournot-Nash does not appreciably change the market price and so the contracting firms can hardly even notice if one firm expands, as seen in Figure 4.

We will investigate further the actual behavior of these "groping" firms in Section 7. For now, it suffices to recognize that such firms regularly fail to move in the direction which maximizes profits and inquire as to why they so fail.

The terrain for every firm is in fact fixed. The reason why competitive firms do not magically head off toward the peak is that the terrain is different for every firm, even if the firms are identical. In general, $\pi_1(q_1, q_2) \neq \pi_2(q_1, q_2)$. Further, no firm would see the collusive outcome as the top of the hill - but this is precisely *because* as in the above figures the peak of the mountain is where they monopolize the market and everyone else goes away. The peak will never be reached because firms disagree as to where the peak exists, and no firm has control over how the other firms operate.

This is exactly the significance of the Cournot equilibrium. Looking at its own map, every firm is there indifferent to marginal changes in its own output and so no firm has incentive to change. Thus, the Cournot levels are stable. This is what defines Cournot production as an equilibrium. On the other hand, at the point of collusion every firm looks at its map and sees greater profits with increased output and so every firm has incentive to expand. This instability in the face of competition for greater profits is what distinguishes the collusive outcome from a competitive equilibrium.

Nor may it be considered rational for firms to behave so that the vector of firm outputs moves in the direction of steepest ascent and so tend toward the collusive result. Rather, each firm reckons the steepest ascent of *its* profits to be in a different direction. There is no consistent direction for the vector of firm outputs to move. Some other explanation is required.

6.3 A note on "irrationality"

The authors note that "30% irrationality...is sufficient to ensure competitive pricing." Irrationality here being "the probability that an agent makes the opposite decision to the rational one" [6, Sec. 3.1]. Of course, by "rational" the authors mean that a firm follows their hill-climbing algorithm. That is, it is "irrational" for the firm to believe that it will have higher profits by stepping in the opposite direction, even if we know objectively that the firm is correct in its belief.

The reason that some measure of "irrationality" yields "competitive pricing" is that such firms are not consistently fooled by the wagon effect. What the authors call "irrationality" would be better described as "the firm occasionally testing its assumption that its own production decision was responsible for the direction of its change in profits."

Such firms take a more experimental approach rather than follow blindly the advice of Standish and Keen. Suppose that the firm changes course with nonzero probability $1/[1+\exp(\Delta\pi/T)]$. That way, when profits are rising rapidly, the firm is almost certain to continue, flips a coin when profits are unchanged, and when profits fall rapidly the firm is almost certain to reverse course.

The results are to some degree dependent upon the choice of T. An overly large T approaches a random walk, while a decidedly small T approaches the asserted firm behaviour of Keen and Standish. Between, firms are less fooled by the wagon and yet do not spend an inordinate amount of time experimenting.

Far from "irrational", such activity directly fills in an important blind spot in the "rational" approach of Standish and Keen.

6.4 Standish-Keen dynamics

The authors argue that their firms' behavior implies "that the Cournot [duopoly] equilibrium is unstable in the direction of both firms decreasing production." But the authors say nothing whatsoever about the stability of the Cournot model of imperfect competition. Simply, they argue that if firms are given different information and forced to follow a particular strategy, that they will not operate like firms which are not so restricted.

The authors implicitly argue that if firms follow their given strategy, that they all get higher profits than if the firms produce at Cournot levels. Thus, they argue, their strategy is, *prima facie*, more rational. It is certainly more rational in the sense that collusion is more rational than ruinous competition. Neoclassical oligopoly theory agrees that the rational strategy is to collude. Rather, the question is whether such an equilibrium is *competitive*. We have seen above that oligopolists following the production strategy of Standish and Keen often will be misled into passing on opportunities for higher profits.

Consider, then, the simple case of an oligopoly of N identical firms with zero costs facing linear demand such that

$$P(Q^d) = \alpha - \beta Q^d$$

According to the authors, the industry will supply $Q^s = \alpha/2\beta$, resulting in a price $p = \alpha/2$.
Each firm then receives a profit of $\pi_i = \alpha^2/4N\beta$.

Suppose one firm recognizes that movements in its short-run profits are driven by industry and not itself. It then pursues the following strategy: Select a new output, hold there until the industry settles into a new *equilibrium*, and then evaluate its decision based on the new equilibrium rather than the transient response of the other firms. To avoid confusion with any equilibrium of strategies, let us call this post-transient response the "medium-run" levels of output and profits.

So long as firm i holds its output at q_i, this effectively removes that amount from demand as seen by the rest of industry. That is, the remaining $N-1$ firms face residual demand

$$P(Q^r) = (\alpha - \beta q_i) - \beta Q^r$$

and therefore the $N-1$ firms supply $\alpha/2\beta + q_i/2$,resulting in a price $p = \alpha/2 - \beta q_i/2$. Thus, firm i received medium-run profits of

$$\pi_i(q_i) = \frac{\alpha - \beta q_i}{2} q_i$$

If all other firms follow Standish and Keen, then firm i maximizes its long-run profits by selecting the level of output which maximizes medium-run profits. Specifically, the firm produces N times its Standish-Keen amount ($q_i = \alpha/2\beta$) and accepts a price half that of Standish-Keen ($p = \alpha/4$) for profits of $\pi_i = \alpha^2/8\beta -$ that is, $N/2$ times greater.

Thus, firm i is no worse off in the case of duopoly, and has greater long-run profit incentive the greater the number of competitors. So each firm has incentive to change strategy pursuit of greater long-run profits. There are two ways of preventing such a competitive firm from seeking these greater profits. Either such profit-seeking behavior is assumed away or the firms must be allowed to agree among themselves not to engage in the behaviour – that is, to collude.

7. Understanding the simulated dynamics

As we have seen in Section 6 the proposed "Keen equilibrium" is not in fact a competitive equilibrium as all firms must agree not to pursue an alternative strategy that exposes opportunities for greater profit. Standish and Keen attempt to demonstrate that their claims are still valid by running computer simulations of firms following the suggested strategies. One important feature of the strategy is that the firm is assign a fixed but not necessarily identical step size. This leads to an unequal division of the market even if the firms are otherwise identical. As it turns out, the market share of each firm playing the author's strategy is directly related to its assigned step size. Finally, we see how this result is connected to the wagon effect. Consider again our greatly stripped-down example of linear demand and zero production costs, so that

$$\pi_i(q_1, q_2, \dots, q_N) = \left[\alpha - \beta \sum_{j=1}^{N} q_j\right] q_i$$

Now Standish and Keen's firms do not know the specific shape of the demand curve, so let us weaken again our example by saying that they do know that demand is linear and so firm i does believe that

$$\pi_i(q_1, q_2, \dots, q_N) = \left[\alpha_i - \beta_i \sum_{j=1}^{N} q_j\right] q_i$$

Suppose then, that having received a price p for its product firm i expands production from q_i to $q_i + \delta_i$ and its profits fall, so that it believes that its profits would have been no worse had it instead contracted. That is,

$$(p + \beta_i \delta_i)(q_i - \delta_i) \geq (p - \beta_i \delta_i)(q_i + \delta_i)$$

or

$$\beta_i \delta_i \geq p \qquad (7.1)$$

That is, from "Keen equilibrium" when the firm thinks it over-expanded from its "equilibrium" share $\ell_i = q_i / Q^s$, it believes that

$$\beta_i \geq \frac{p}{q_i} = \frac{p}{\ell_i Q^s} = \frac{\alpha/2}{\ell_i \alpha/2\beta} = \frac{\beta}{\ell_i}$$

Likewise, when the firm thinks it over-contracted, it believes that $\beta_i \leq \beta/\ell_i$. Thus, every firm systematically overestimates the elasticity of demand.

Recall from the previous section, however, that a firm facing competitors that follow Standish and Keen and which *believes* that the slope of the inverse demand curve is $-\beta_i$ would then *believe* that it maximizes long-run profits by producing at the level $q_i - \alpha/2\beta_i$. So in "Keen equilibrium" such a firm would *think* it is maximizing long-run profits by producing at $q_i = \ell_i\alpha/2\beta -$ exactly where the authors argue the equilibrium exists.

In other words, a firm following Standish-Keen gets a false idea of how elastic demand is, and so thinks it would do exactly as well pursuing the strategy described above. Unfortunately, the notion is predicated on the false estimate of demand elasticity; a firm which actually varied its output in the manner described in the previous section would find itself with higher profits – in the short term as well as the long. What remains is to more carefully derive the actual "equilibrium" outputs.

7.1 A simplified derivation

A full derivation of market shares requires a deal more space than this note allows. However, suppose that firm i has constant marginal costs c_i and constant step size δ_i. Suppose also that the industry faces linear demand such that if the output of firm i in period t is given by $q_{i,t}$ then market price in the same period is

$$p_t = \alpha - \beta Q_t = \alpha - \beta \sum_j q_{j,t}$$

Profits in the next period are given by

$$\begin{aligned}\pi_{i,1} = (p_1 - c_i)q_{i,1} &= (p_1 - c_i)q_{i,0} + (p_1 - c_i)\left(q_{i,1} - q_{i,0}\right) \\ &= (p_0 - c_i)q_{i,0} + (p_1 - p_0)q_{i,0} + (p_1 - c_i)(q_{i,1} - q_{i,0})\end{aligned}$$

Which is to say that a firm switches between expansion and contraction when

$$\Delta\pi_{i,t} = (-\beta\Delta Q_t)q_{i,t} + (p_{t+1} - c_i)\Delta q_{i,t} \leq 0$$

That is, (5.2) describes not merely the proposed equilibrium, but the general behavior of firms following the strategy of Keen and Standish. To speed things along, let us stipulate that in "equilibrium" expansion and contraction of all firms are synchronized so that

$$\frac{\Delta q_{i,t}}{\Delta Q_t} = \frac{\delta_i}{\sum_j \delta_j}$$

When contracting, firms switch to expansion when

$$\left(\beta \sum_j \delta_j\right) q_{i,t} \leq (p_{t+1} - c_i)\delta_i$$

and when expanding, firms switch to contraction when

$$\left(\beta \sum_j \delta_j\right) q_{i,t} \geq (p_{t+1} - c_i)\delta_i$$

Thus, synchronized firms move toward

$$\frac{\sum_j \delta_j}{\delta_i}(-\beta)q_{i,t} + p_{t+1} - c_i = 0 \qquad (7.2)$$

which is to say they behave almost identically to Cournot oligopolists, except that they perceive the slope of the inverse demand curve to be not $-\beta$ but rather

$$\frac{-\beta}{\delta_i / \sum_j \delta_j}$$

When (7.2) applies to all firms in the industry,

$$\left(\beta \sum_i \delta_i\right) Q_t = \left(\beta \sum_i \delta_i\right) \sum_i q_{i,t} = \left(\alpha - \beta Q_t \mp \beta \sum_i \delta_i\right) \sum_i \delta_i - \sum_i \delta_i c_i$$

so

$$2\beta Q_t = \alpha - \frac{\sum_i \delta_i c_i}{\sum_i \delta_i} \mp \beta \sum_i \delta_i$$

and

$$2\beta Q_{t+1} = 2\beta\left(Q_t \mp \sum_i \delta_i\right) = \alpha - \frac{\sum_i \delta_i c_i}{\sum_i \delta_i} \mp \beta \sum_i \delta_i$$

so that

$$\frac{Q_t + Q_{t+1}}{2} = \frac{\alpha - c_\delta}{2\beta}$$

where c_δ is the δ -weighted average marginal cost across firms. Thus, the industry operates on average as if a monopoly with marginal cost c_δ. Call this industry average Q_δ. In addition,

$$\beta q_{i,t} + \beta q_{1,t+1} = 2\beta q_{i,t} \mp \beta \delta_i = (p_{t+1} - 2c_i)\frac{\delta_i}{\sum_j \delta_j} - \beta \delta_i$$

$$= \left(\alpha + c_\delta + \beta \sum_j \delta_j - 2c_i\right)\frac{\delta_i}{\sum_j \delta_j} - \beta \delta_i = [\alpha - c_\delta - 2(c_i - c_\delta)]\frac{\delta_i}{\sum_j \delta_j}$$

so

$$\frac{q_{i,t} + q_{i,t+1}}{Q_t + Q_{t+1}} = \frac{2\beta Q_\delta - 2(c_i - c_\delta)}{2\beta Q_\delta}\frac{\delta_i}{\sum_j \delta_j} = \left[1 - \frac{c_i - c_\delta}{\beta Q_\delta}\right]\frac{\delta_i}{\sum_j \delta_j}$$

Note also that if marginal costs are equal across firms (or, if n any case, $c_i = c_\delta$) then

$$\frac{q_{i,t} + q_{i,t+1}}{Q_t + Q_{t+1}} = \frac{\delta_i}{\sum_j \delta_j}$$

That is, the assignment of δ to the firm determines the firm's market share and therefore firm profits. These results are confirmed via simulation, and are available in HTML/Javascript at Test of “Keen Equilibrium”.

7.2 Discussion

As we have seen, the firms of Standish and Keen actually do behave as if following equation (5.1), even if this is an illusion brought on by the strategy assigned to (not chosen by) the firm. As we have just seen, even if the firm followed broadly the assigned strategy, it would benefit the firm to choose a larger step size. Thus, the proposed equilibrium depends on the firm convincing itself in the non-existence of profit opportunities which do in fact exist. If all other firms follow the strategy, the firm need only expand to increase its profits. Such results depend on the firm's near-total ignorance. Even if the firm believes it is in a Keen equilibrium and by any means happens to discover its market share, then it would know β and would know it would profit by expanding output.

As suggested earlier, the firm could profit by recognizing that its short-run profits are often driven by its competitors' movements more so than its own. If, as in Section 6.4, firm i picks an output q_i and holds it there, then rest of industry will see

$$p(Q^r) = (\alpha - \beta q_i) - \beta Q^r$$

where Q^r is supply from of all other firms. From the perspective of all other firms it is as though demand had fallen by q_i, but the number of firms in the oligopoly had also fallen by one. Thus, the rest of industry reacts to firm i's choice of output by supplying

$$Q^r = \frac{(\alpha - \beta q_i) - c_\delta^r}{2\beta} = \frac{\alpha - c_\delta^r}{2\beta} - \frac{q_i}{2}$$

where c_δ^r is the δ-weigthed average firm marginal cost among all other firms. Thus, industry supplies

$$Q^s = \frac{\alpha - c_\delta^r}{2\beta} + \frac{q_i}{2}$$

leaving a market price of

$$p = \frac{\alpha + c_\delta^r}{2} - \frac{\beta}{2} q_i$$

and therefore firm i received equilibrium profits of

$$\pi_i = \frac{1}{2}[(\alpha - c_i) - (c_i - c_\delta^r) - \beta q_i] q_i$$

As firm I experiments with variations in q_i, it finds that is maximizes profits by producing where

$$2\beta q_i = (\alpha - c_i) - (c_i - c_\delta^r)$$

Noting that

$$c_\delta^r \left(\delta_i - \sum_j \delta_j \right) = \delta_i c_i - c_\delta \sum_j \delta_j$$

So

$$(c_\delta^r - c_i) \left(\delta_i - \sum_j \delta_j \right) = c_i - c_\delta \sum_j \delta_j$$

We find that the best long-run profits seen by such a competitor is achieved at

$$q_i = \frac{1}{2\beta}\left(\alpha - c_i - \frac{c_i - c_\delta}{1 - \delta_i / \sum_j \delta_j}\right)$$

and so operates near to the monopoly level.

A more detailed analysis is provided in the Technical Appendix, but the bottom line is that so long as all firms are following the strategy of Standish and Keen, then few (if any) firms fully pursue opportunity for profit. It does not matter that such competition would be ruinous; only by choosing not to pursue such profits is the authors' result obtained. The result is not a *competitive* equilibrium.

8. Conclusions

The critique by Keen and Standish on the theory of the firm is deficient on every front. Their critique of perfect competition depends on an unaccepted definition of price-taking that confuses textbook models of perfect and imperfect competition. Their critique of Cournot-Nash relies upon firms neither understanding the tradeoff it faces nor how to deal with that lack of understanding. As a result, the firms of Keen and Standish superficially seek out greater profits but forgo profit opportunities by failing to act in their objective best interests. In contrast to the authors contention, firms forced to grope in order to maximize profits are capable of working around the informational limitations Keen and Standish impose in modifying the Cournot game. Standish and Keen may not explicitly model firms' communications with one another, but the firms must somehow come to agreement not to pursue individual strategies which yield greater profits. Either the firms agree among themselves or Standish and Keen simply forbid the strategies. The “Keen equilibrium” is therefore no more competitive than any collusive oligopoly.

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Technical Appendix: A Better Response to Keen-Standish "hill climbers"

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1. Keen "equilibrium"

If all firms follow the strategy suggested by Standish and Keen, and all firm synchronize their movements in output then each firm "gropes" toward

$$q_i^{KS} = \frac{p^{KS} - c_i}{\beta}\frac{\delta_i}{\sum_j \delta_j}$$

as in [1, Section 7.1], resulting in price

$$p^{KS} = \alpha - \beta \sum_i \frac{p^{KS} - c_i}{\beta}\frac{\delta_i}{\sum_j \delta_j} = \alpha - \frac{\sum_i (p^{KS} - c_i)\delta_i}{\sum_i \delta_i} = \alpha - p^{KS} + c_\delta$$

or

$$p^{KS} = \frac{1}{2}\alpha + \frac{1}{2}\frac{\sum_i \delta_i c_i}{\sum_i \delta_i} = \frac{\alpha + c_\delta}{2}$$

where c_δ is the δ-weighted average marginal cost across firms. That is,

$$p^{KS} - c_i = \frac{1}{2}[\alpha + c_\delta - 2c_i] = \frac{1}{2}[(\alpha - c_i) - (c_i - c_\delta)]$$

resulting in profits

$$\pi_i^{KS} = \frac{1}{4\beta}\frac{\delta_i}{\sum_j \delta_j}[(\alpha - c_i) - (c_i - c_\delta)]^2 \qquad (1)$$

Thus, the profits of firm i increase with the firm's δ-share

$$\theta_i \equiv \frac{\delta_i}{\sum_j \delta_j}$$

but if the firm's marginal cost is lower than that of its competitors, a greater δ lowers the average marginal cost and therefore the supply price. Defining relative marginal cost

$$\xi_i \equiv \frac{c_i}{c_\delta^r}$$

We may rewrite (1) as

$$\pi_i^{KS} = \frac{\theta_i}{4\beta}\left[(\alpha - c_i) - (1-\theta_i)(1-\frac{1}{\xi_i})c_i\right]^2$$

Figures 1 and 2 show the profits of a firm in Keen "equilibrium".

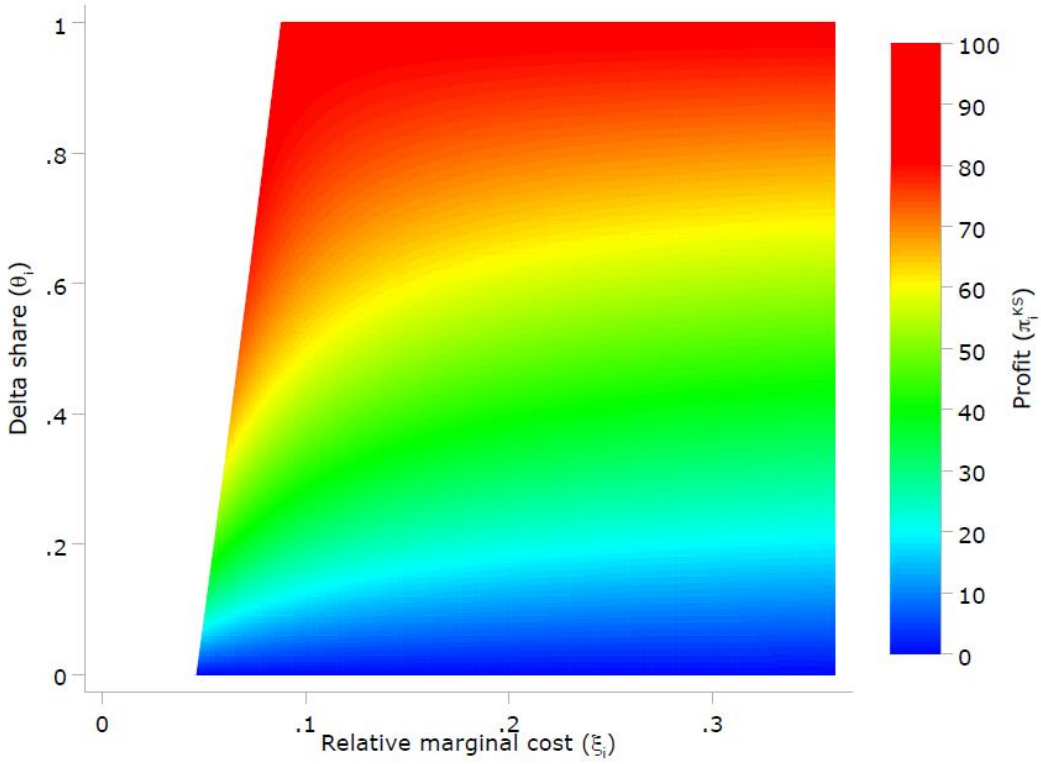

Figure 1: Profits of a firm with lower marginal cost

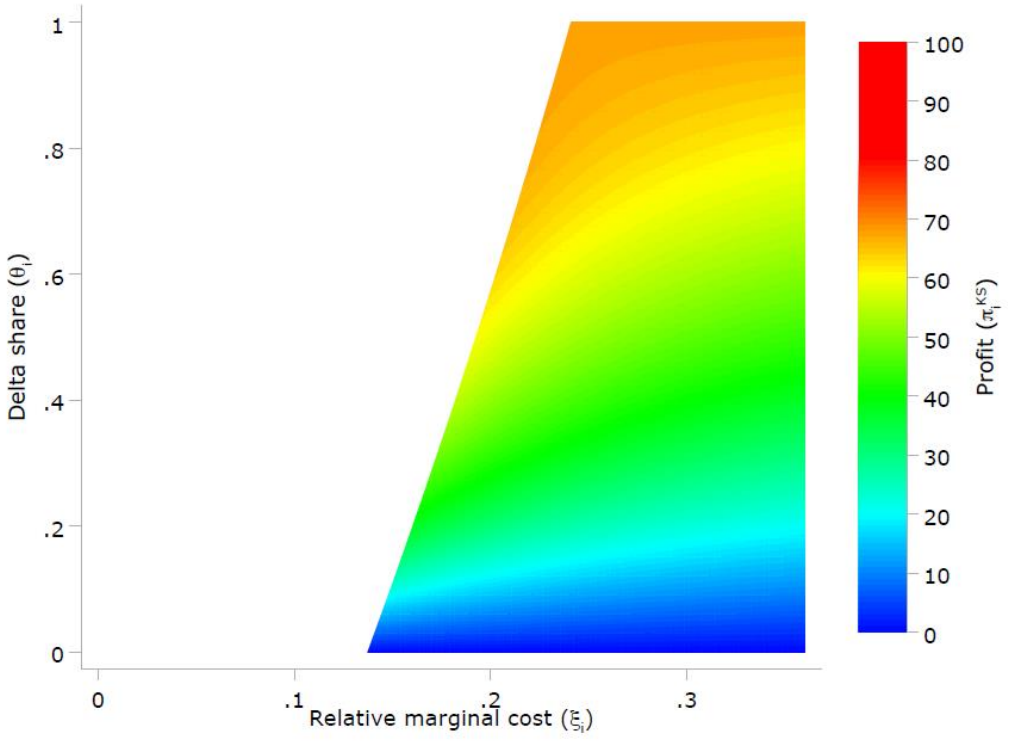

Figure 2: Profits of a firm with higher marginal cost

As is apparent from these figures, for any ξ_i a larger θ_i means higher profits. However, if the firm's marginal cost is sufficiently low relative to its competitors, there is a limit to how much of the market it may capture before guaranteeing that at least one other firm will be unprofitable. If all firms have positive profits then the residual average marginal cost must be less than the price, or

$$2c_\delta^r < 2p^{KS} = \alpha + c_\delta = \alpha + \theta_i\xi_i c_\delta^r + (1-\theta_i)c_\delta^r$$

That is,

$$(1-\xi_i)\theta_i < \frac{\alpha}{c_\delta^r} - 1$$

If ξ_i is sufficiently small the market price must be too low for all firms to operate profitably. At least one high-cost firm must drop out, lowering the average marginal cost of its competitors c_δ^r and increasing ξ_i. Thus, firm i cannot operate in the region to the left of the regions indicated in Figures 1 and 2.

Note, however, that everywhere else, the firm has higher profits the greater the firm's δ-share. That is, a firm following the strategy of Standish and Keen should not satisfy itself with whatever δ the authors assign it. Rather, the firms prefer a δ very large in comparison to its competitors.

2. One firm changes strategy

If all other firms follow the strategy described by Standish and Keen, but firm i instead follows the strategy described in [1, Section 6.4] then firm i produces

$$q_i^S = \frac{1}{2\beta}[(\alpha - c_i) - (c_i - c_\delta^r)]$$

resulting in a price such that

$$p - c_i = \frac{\alpha + c_\delta^r}{2} - \frac{1}{4}[(\alpha - c_i) - (c_i - c_\delta^r)] - c_i = \frac{1}{4}[(\alpha - c_i) - (c_i - c_\delta^r)]$$

and profits

$$\pi_i^S = \frac{1}{8\beta}[(\alpha - c_i) - (c_i - c_\delta^r)]^2 = \frac{1}{8\beta}\left[(\alpha - c_i) - \left(1 - \frac{1}{\xi_i}\right)c_i\right]^2 \qquad (2)$$

3. Choice of response to Standish-Keen competitors

If we persist in assuming firms are stuck with their assigned δ and $c_i = c_\delta$, then

$$\pi_i^{KS} = 2\theta_i\pi_i^S$$

so any firm with less than half the δ share would be better off changing strategies. In general, a firm must have a considerable δ-share to justify sticking with the advice of Standish and Keen. For a given θ_i, the strategies break even when

$$[(\alpha - c_i) - \left(1 - \frac{1}{\xi_i}\right)c_i]^2 = 2\theta_i[(\alpha - c_i) - (1-\theta_i)\left(1 - \frac{1}{\xi_i}\right)c_i]^2$$

or

$$\left(1 - \frac{1}{\xi_i}\right)c_i = \frac{1 - \sqrt{2\theta_i}}{1 - (1-\theta_i)\sqrt{2\theta_i}}(\alpha - c_i)$$

As Figure 3 shows, this line divides the ξ- θ map into two regions: the "Keen" region where it is more profitable for the firm to follow the strategy of Standish and Keen, and the "Stackelberg" region, where it is more profitable to operate at a steady level of output and let the rest of the competition settle into a "Keen equilibrium".

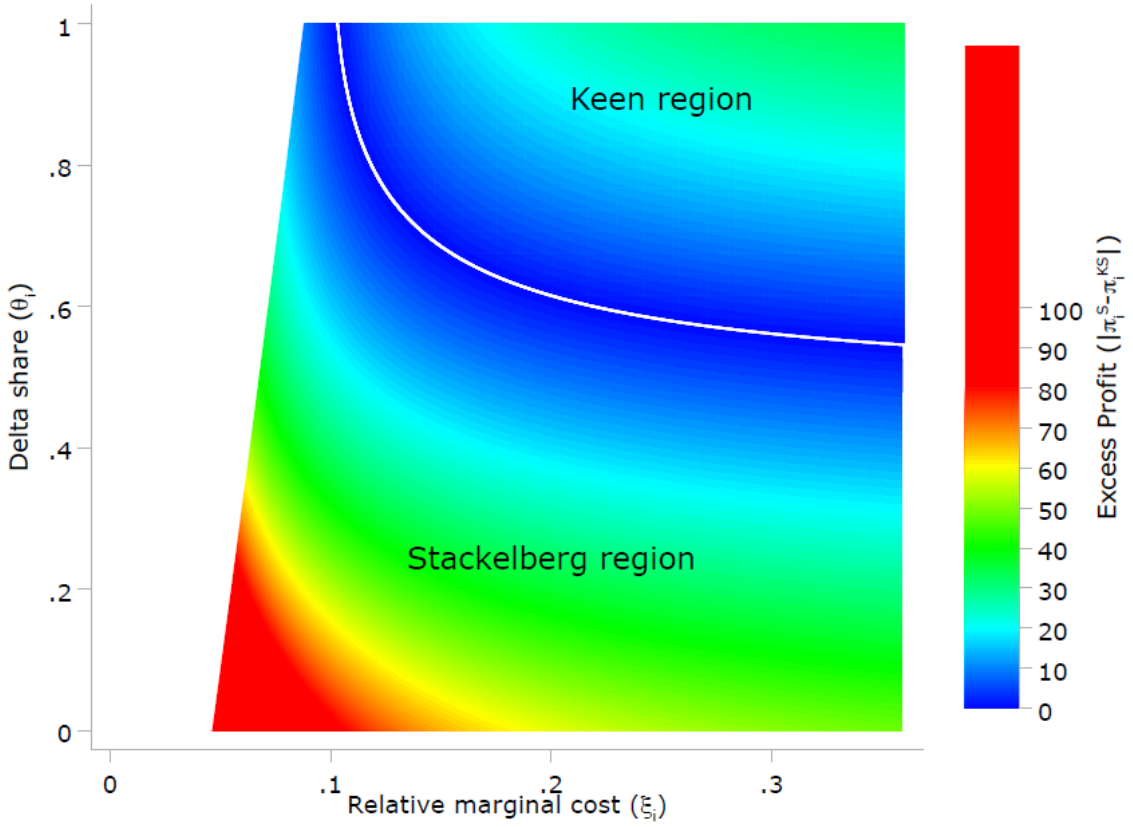

Figure 3: Absolute difference in profits between strategies

The Standish-Keen strategy requires a very large δ share indeed.

4. Analysis of the Standish-Keen simulations

Let us conclude with the parametrization presented in [2]. There,

$$P(Q^s) = 11 - \frac{1}{3}Q^s$$

and all firm marginal costs $c \in [0.5; 1.5)$. For a firm with the lowest possible marginal cost, $\xi \in (\frac{1}{3}, 1]$; for a firm with the highest, $\xi \in [1, 3)$. In Figures 4 and 5 we see the ξ- θ maps for the lowest and highest marginal cost firms, respectively.

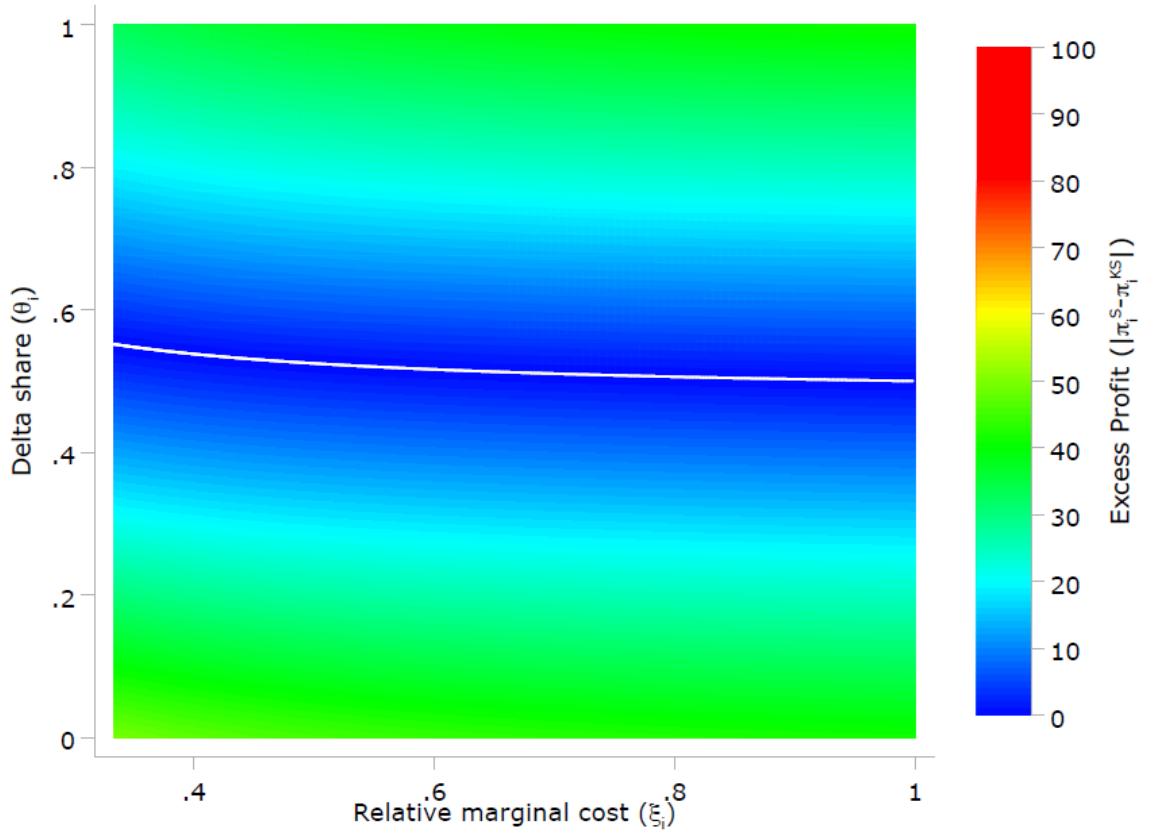

Figure 4: ξ- θ map for $c = 0.5$

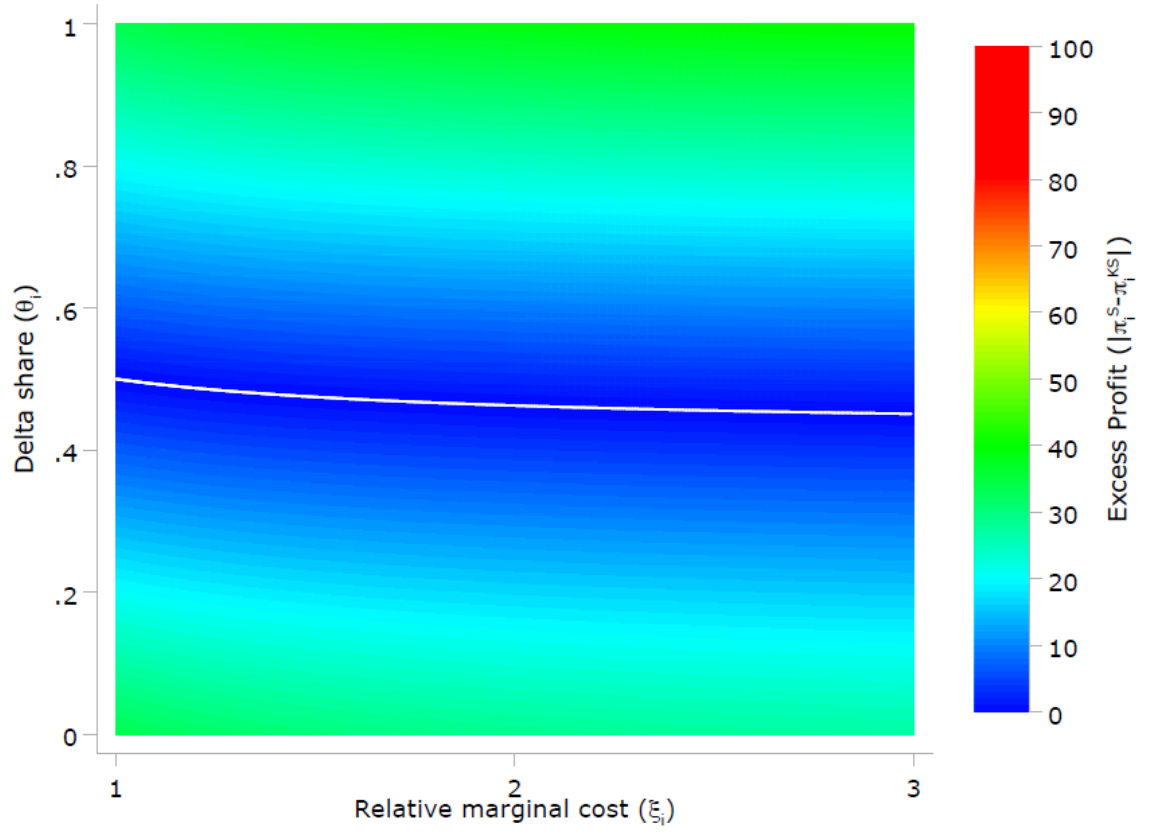

Figure 5: ξ- θ map for $c = 1.5$

Clearly, in the simulations of Standish and Keen, nearly every firm would profit from a change in strategy. With 1,000 firms in competition, for a firm to see even $\theta > 1/10$ this would require the firm to have a step size 111 times larger than the average of its competitors. The authors' chosen parameterization of the half-normal distribution of δ is not nearly wide enough to make such an event likely. Regardless, at most two firms would fail to benefit from a change in strategy. The Keen result is not a competitive equilibrium.

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Response to David Rosnick's "Toward an Understanding of Keen and Standish's Theory of the Firm: A Comment"

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Rosnick makes a lot of detailed points, but has failed to understand exactly what theory we are criticising. He organises his response according to three rather interwoven threads, to which we will only respond to the most important issues, rather than make a detailed point-by-point response.

We will start with the issue that Rosnick completely failed to discuss (and which we therefore label as Thread 0): that the so-called profit-maximizing formula for an individual firm – of equating marginal cost and marginal revenue – provably does not maximize profits in any industry structure apart from monopoly.

Thread 0

Standard Neoclassical pedagogy teaches that, regardless of market structure, an individual firm in an industry will maximize its profits by equating its marginal revenue (the derivative of its revenue to its output) to its marginal cost (the derivative of its total cost of production with respect to its output):

$$\frac{\partial \pi_i}{\partial q_i} = \frac{\partial (P(Q) \cdot q_i)}{\partial q_i} - \frac{\partial TC_i(q_i)}{\partial q_i}. \qquad (1)$$

However, given the standard Neoclassical assumptions of falling marginal revenue and rising marginal cost [1, 2][1] the profit maximum for any individual firm is found, not by setting what is in fact the *partial derivative* of its profit to zero, but by setting the *total derivative* of its profit to zero:

$$\frac{d\pi_i}{dQ} = \sum_j \frac{\partial \pi_i}{\partial q_j} \frac{\mathrm{d}q_j}{\mathrm{d}Q} = 0. \qquad (2)$$

Our paper in this issue generalizes our earlier analysis to cover asymmetric firm response, but in the interests of illustrating the crucial point that Rosnick ignores, we provide a simple comparison of the standard "Neo-classical profit maximization" formula and the actual profit maximization formula in the case of n identical firms in an industry.

Consider a linear demand curve $P(Q) = a - bQ$ and an industry with n identical firms, where each firm has the identical total cost function $TC(q) = k + cq + dq^2/2$. Then the total revenue for an individual firm will be $TR(q) = P(Q)q = aq - bnq^2$ and profit will be:

$$\pi(q) = a \cdot q - b \cdot n \cdot q^2 - \left(k + c \cdot q + \frac{1}{2} \cdot d \cdot q^2\right) \qquad (3)$$

[1] The assumption of rising marginal cost has been found to be false by all empirical studies of firm cost structures. See [2] for a survey and [1, Chapter 4] for the most recent research.

Applying Stigler's rule [3, p. 8 footnote 31] that $\partial P/\partial q_i = dP/dQ$, we can derive marginal revenue for the individual identical firm as $MR(q) = P + qdP/dQ = a - b(n+1)q$, while marginal cost is $MC(q) = c + dq$. The output level q_N that results from following the Neoclassical rule of equating marginal revenue and marginal cost is:

$$q_N = \frac{a-c}{(n+1)b+d} \tag{4}$$

In the case of n identical firms, the actual ("Keen") profit maximization formula can be written as:

$$MR(q) - MC(q) = \frac{n-1}{n}\big(P(nq) - MC(q)\big) \tag{5}$$

The solution q_K to this formula is:

$$q_K = \frac{a-c}{2bn+d} \tag{6}$$

The profit level that results from the q_K level of output exceeds that from the q_N level for $n > 1$:

$$\pi(q_K) - \pi(q_N) = \frac{b^2\,(a-c)^2(n-1)^2}{2(2bn+d)(b+d+bn)^2} > 0 \forall n > 1. \tag{7}$$

For a numerical illustration, consider an example with parameter values $a = 100$, $b = 10^{-6}$, $c = 20$, $d = 10^{-5}$, $k = 10000$ and 100 firms ($n = 100$). In this case the profit per firm from the q_K level of output is 1.523×10^7 versus 3.107×10^6 for the q_N level of output. Equating marginal cost and marginal revenue is therefore not a profit-maximizing strategy for the individual firm – though it may be the result of competitive interactions between firms. Our paper considers the stability of these interactive strategies.

Thread 1

The theory we're critiquing is the Marshall theory of the firm, which like the Cournot ologopolists, consists of price-taking agents operating in a clearing market with the market prices determined by a given function of total production Q. There is no separate supply and demand Qs, or if there are, they are identical, always. The Marshall model also supposes perfect competition, namely that the individual firms have no influence on market price, or $\partial P/\partial q_i = 0$, which as Rosnick agrees with us, is simply incompatible – a logical fallacy.

Thread 2

Given that the construction of the Marshall model (minus the perfect competition condition imposed by fiat) is also the same as classical Cournot analysis, Rosnick turns his attention to the Cournot game. However, the Cournot game is defined as a single shot game, where firms must make decisions on their output, accept the profit received and that is the end of the game. Again, the model we're critiquing is not that, as firms iteratively set production values and receive profits, thus allowing agents to gain information about each other inductively. Just as semi-cooperative strategies beat totally defecting strategies in iterated prisoners dilemma, the same happens in the Marshall model.

It is true that we haven't specified dynamical equations for the Marshall model, as the model is not sufficiently detailed to specify it completely, but suppose the dynamical equations are:

$$\frac{d\mathbf{q}}{dt} = \mathbf{F}\big(\boldsymbol{\pi}(\mathbf{q})\big), \tag{8}$$

where $\mathbf{q} = (q_1, q_2, \ldots, q_n)$, $\boldsymbol{\pi} = (\pi_1, \pi_2, \ldots., \pi_n)$ and generally we denote vector values quantities in bold face. $\mathbf{F}$ has to be a function of the profit vector $\boldsymbol{\pi}$, as the agents' behaviour is entirely determined by their profit seeking rationality.

Eq (8) only has equilibria where the derivative $D_{\mathbf{q}}F = 0$, or equivalently where $\partial F_i / \partial q_j = 0, \forall i, j$. The chain rule is

$$D_{\mathbf{q}}F = D_{\boldsymbol{\pi}}\mathbf{F} \cdot D_{\mathbf{q}}\boldsymbol{\pi}, \qquad (9)$$

where $\cdot$ is the usual matrix multiplication. Assuming $D_{\boldsymbol{\pi}}\mathbf{F}$ is full rank, then the only equilibria occur when $\partial \pi_i / \partial q_j = 0, \forall i, j$ which, as we show in our paper, is only possible for the trivial solution $Q = 0$. Indeed the simplest scenario is for $D_{\mathbf{q}}\mathbf{F}$ to be proportional to $D_{\mathbf{q}}\boldsymbol{\pi}$, in which case each firm is equally striving to improve its own profit independently of the others.

The Cournot outcome has an unstable manifold, where overall production is declining leading to rising profits for all. The only way to prevent the system from taking that path is to explicitly inhibit it in some way – it might be said that prevention of collusion is sufficient to prohibit this from occurring, but the simple agent model we provide is a counter example, where non-collusive firms nevertheless end up at monopoly-like market levels.

But if an actual mathematical equilibrium does not exist, there is still the possibility of a *macroeconomic equilibrium*, where the individual firm's profits do not change as total production Q changes, ie

$$\frac{d\pi_i}{dQ} = 0. \qquad (10)$$

This is the origin of the Keen formula. Expanding (10) as

$$\frac{d\pi_i}{dQ} = \sum_j \frac{\partial \pi_i}{\partial q_j}\frac{dq_j}{dQ} = 0, \qquad (11)$$

and substituting into a linearised version of (8) around a Keen outcome $\mathbf{q}^K$, we get

$$\frac{d\mathbf{q}}{dt} = \sum_j \frac{\partial \pi_i}{\partial q_j}\left(q_j - q_j^K\right) \qquad (12)$$

$$= \quad 0 \text{ if } Q - Q^K \neq 0.$$

The condition describes not an equilibrium point, but rather an equilibrium manifold of constant total market production, which is stabilised by the agents ensuring that if any agent were to cause the system to stray from this manifold, then all agents will follow suit, causing that agent to not enjoy its advantage for long. Any rational agent will then return to the fold.

Thread 3

This focuses on the simple agent model we use to explore this issue. Rosnick compares the model to agents dancing in a wagon careering downhill. Whilst poetic, it is not a useful metaphor, chiefly because with the wagon, the system's dynamics are largely determined by the trajectory of the wagon, not the individual agents, whereas with our model, the dynamic behaviour is completely determined by the actions of the agents.

In §6.3, Rosnick introduces a variant of our agents where the decision is made to reverse the usual decision with small probability that increases the closer to equilibrium the system is. Undoubtedly, this could

be done so as to benefit the agent concerned, to the detriment of the other agents in the system, however this action cannot be considered rational. Rational agents always choose the optimum action — the only time rational agents are permitted to act stochastically is when multiple equally valued courses of action are available.

Rational agents should be aware of the possibility that their competitors may not be similarly rational, and take suitable action when they find their market share being stolen from them. Admittedly, the agents specified in our paper are not sophisticated enough to do this, but this was a deliberate choice, since we wanted to show that agents following a simple iterative and non-collusive algorithm would choose output levels that clustered around the true profit-maximizing level of output, and not the Cournot level.

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